Regulations and Curriculum for

Bachelor of Technology (B.Tech.) in Mechanical Engineering

For aritulation details of PSU 2+2 program (Refer page number 11)

NITTE (Deemed to be University)

(Established under Section 3 of UGC Act, 1956)
Placed under Category ‘A’ by MHRD, GoI | Accredited with ‘A+’ Grade by NAAC

Regulations and Curriculum for

Bachelor of Technology (B. Tech.)

Choice Based Credit System (CBCS)
Effective from AY 2023-24

NITTE
(Deemed to be University)

(Deemed to be University under Section 3 of UGC Act, 1956)
(Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A+' Grade by NAAC)
University Enclave, Medical Sciences Complex, Deralakatte,
Mangaluru – 575 018, Karnataka INDIA
Tel: +91-824-2204300/01/02/03, Fax: 91-824-2204305
Website: www.nitte.edu.in E-mail: info@nitte.edu.in

VISION

To build a humane society through excellence in the education and healthcare

MISSION

To develop
Nitte (Deemed to be University)
As a center of excellence imparting quality education,
Generating competent, skilled manpower to face the scientific and social
challenges with a high degree of credibility, integrity,
ethical standards and social concern

Regulations and Curriculum
B.Tech. Degree Programs
Choice based Credit System
(CBCS)

Effective from

Academic Year

2023 – 2024

Curriculum for Acquiring Professional Skills (CAPS)

With Scheme of Teaching & Examination

REGULATIONS: 2023

COMMON TO ALL

B.Tech. DEGREE PROGRAMS

CHOICE BASED CREDIT SYSTEM

(CBCS)

Version 2023.01-PSU

Choice Based Credit System (CBCS)

1. Choice for the selection of courses during each semester.
2. Choice in planning the academic activities by selecting desired number of courses per semester.
3. Balanced curriculum with engineering, science, humanities, and management courses.
4. Project based learning (PBL) which focusses on experiential learning.
5. Opportunities to study inter-disciplinary courses.
6. Enabling slow learners by offering important courses in all semesters.
7. Optional Summer semester
8. Opportunity to get associated in research projects to acquire research experience.
9. Value addition with Honors / Minor credentials.

Curriculum for Acquiring Professional Skills (CAPS)

1. Practicing outcome-based education (OBE) where Courses made student-centric rather than teacher-centric.
2. Provisions for courses integrated with Lab/ PBL component.
3. Focus on experiential learning.
4. Ability enhancement and skill development courses as per National Education Policy (NEP) 2020.
5. Focus on Industry Internship and Research Internship.
6. Students to work on real world/interdisciplinary problems in major project.
7. Importance is given to creativity, innovation, and development of entrepreneurship skills.

Key Information

Program Title	Bachelor of Technology Abbreviated as B.Tech. Mechanical Engineering
Short description	Four-year, eight semester Choice Based Credit System (CBCS) type of Undergraduate Engineering Degree Program with English as medium of instruction.
Program Code	14ENGR10D2
Revision version	2023.01-PSU These regulations may be modified from time to time as mandated by the policies of the University. Revisions are to be recommended by the Board of Studies for Mechanical Engineering and approved by the Academic Council.
Effective from	01-08-2023
Approvals	Approved in the 54th Academic Council meeting of NITTE (Deemed to be University), held on 24.06.2023 and vide Notification of Ref: N(DU)/REG/AC-NMAMIT/2022-23/1264 dated 18.07.2023
Program offered at	NMAM Institute of Technology, Off -Campus Centre, Nitte, 574110, Karkala Taluk
Grievance and dispute resolution	All disputes arising from this set of regulations shall be addressed to the Board of Management. The decision of the Board of Management is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to jurisdiction of Courts of Mangalore only

CONTENTS

PREAMBLE

NMAM Institute of Technology (NMAMIT) was established in 1986 and is located at Nitte and off-campus center of NITTE (Deemed to be University), accredited by National Assessment & Accreditation Council (NAAC) with 'A+' grade. NMAMIT is recognized by the All-India Council for Technical Education (AICTE), New Delhi.

The Bachelor of Technology (B. Tech.) Programs focus on Pursuing Excellence, Empowering people, and Partnering in Community Development. Out of fourteen UG Programs i.e., Artificial Intelligence & Machine Learning (AM), Artificial Intelligence & Data Science (AD), Biotechnology (BT), Computer & Communication Engineering (CC), Computer Science & Engineering (CS), Civil Engineering (CV), Electronics & Communication Engineering (EC), Electrical & Electronics Engineering (EE), Information Science & Engineering (IS), Mechanical Engineering (ME), Robotics & Artificial Intelligence (RI), Computer Science & Engineering - Cyber Security (CB), Electronics Engineering - VLSI Design and Technology (VT), and Electronics & Communication - Advanced Communication Technology (AC), all seven eligible UG Programs i.e., BT, CS, CV, EC, EE, IS and ME are accredited by NBA, New Delhi under Tier - I category till 30th June 2025.

The curriculum is jointly approved by members of the Board of Studies (BoS) and Academic Council drawn from academia, Industry, Alumni, and working professionals from Industry, and has been designed to integrate hands-on practical training with the concepts of theory courses to enhance the learning experience.

The Curriculum focuses on students Acquiring Professional Skills (CAPS) through rigorous theoretical training using innovations in pedagogy, experiential learning, active learning, collaborative learning, critical thinking, project planning, Project Based Learning (PBL), Ability enhancement courses for skill-building, effective communication, professional practice, creativity & innovation and developing entrepreneurial skills.

The focus of the Institution is to impart Quality Education to generate competent, Skilled, and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics, and Social Concern.

In the present scenario, students wish to make plans for a bright future. However, student aspirations and industry demands are highly diverse. Employers expect the graduates possess multi-disciplinary competency, Information and Communication Technology (ICT), and leadership skills. In this context, NMAMIT offers the opportunity to the students to select the courses of their choice and helps them in grooming to have well-rounded personalities and become industry ready.

Efforts have been made to make the syllabus compliant with international professional societies. As part of providing quality engineering education, at NMAMIT, Nitte, it has initiated the Choice Based Credit System (CBCS) into its academic curriculum. By this, the students can register for courses of their choice and alter the pace of learning within the broad framework of academic courses and credit requirements. CBCS allows students to plan for their academic load and alter it as they progress in learning. Students also have the option of choosing courses from a pool of courses within each classification. Ample options are given to choose interdisciplinary courses from other programs which will help the student to develop additional skills. Slow learners will also be benefitted since important courses are offered in all semesters. This arrangement helps the students to re-register and clear the backlog courses in the subsequent semester. Suitable provisions are made for fast learners to associate them with research activities of faculty members and contribute to research beyond the working hours.

A faculty advisor helps the student in identifying the courses to be studied in each semester based on program requirements, course prerequisites, student's interest in various disciplines, past academic performance, and courses offered by the departments.

Learning becomes more 'experiential' by carrying out labs associated with theory, mini-projects, and Project Based Learning (PBL) as a part of many courses which enhances the capability of students in understanding and apply Engineering /Technology concepts to solve real life-problems. Hence students will develop the ability to apply the gained knowledge in multi-disciplinary projects and be able to take up major projects based on real-world problems and come up with better solutions while addressing social concerns.

STUDENTS OPTING FOR 2+2 TWINNING PROGRAM OF PSU SHALL REGISTER FOR THE FOLLOWING COURSES DURING 1st to 4th SEMESTERS

1. **NMAMIT Bachelor of Mechanical Engineering (B.Tech ME) Program to the PSU Bachelor of Science in Mechanical Engineering (MECA_BS)**

https://harrisburg.psu.edu/science-engineering-technology/mechanical-engineering-bs

NMAMIT Number	Subject	NMAMIT Credits	PSU Course Equivalent	PSU Credits
MA1009-1	Engineering Mathematics I	4	MATH 140: Calc with Analytical Geometry I	4
CY1001-1	Engineering Chemistry	3	CHEM 110: Chemical Principles	3
CY1001-1	Engineering Chemistry Lab	1	CHEN 111: Experimental Chemistry	1
CV1003-1	Elements of Civil Engineering and Engineering Mechanics	4	PHYS 211: General Physics: Mechanics	4
ME1008-1	Computer-aided Engineering Graphics & Practice	3	EDSGN 100: Introduction to Engineering Design	3
HU1506-1	Overview of Indian Culture	3	Humanities GH	3
MA1010-1	Engineering Mathematics II	4	MATH 141: Calc with Analytical Geometry II	4
PH1001-1	Engineering Physics	4	PHYS 212: General Physics: Electricity and Magnetism	4
HU1509-1	Indian Culture-Yakshagana	3	Art GA	3
MG1507-1	Engineering Economics	3	Social and Behavioral Science GS	3

EE2106-1	Programming for Engineers with MATLAB	3	CMPSC 200: Department-approved elective	3
CV1004-1	Statics*	3	EMCH 211: Statics	3
ME1104-1	Thermal Engineering*	3	ME 300: Engineering Thermodynamics I	3
HU1508-1	Principles of Physical Education	3	Health and Wellness GHW	3
HU1510-1	Indian Culture - Music	3	Art GA	3
HU1501-1	Elements of Yoga	3	Humanities GH	3
MA2012-1	Matrices	3	MATH 220: Matrices	2
CV1006-1	Study of Dynamics*	3	EMCH 212: Dynamics	3
ME1102-1	Mechanics of Materials*	3	EMCH 213: Strength of Materials	3
EE2105-1	Electric Circuits and Power Distribution	3	EE 211: Electric Circuits and Power Distribution	3
MA2011-1	Engineering Mathematics III	4	MATH 251: Department-approved Elective	4
HU1511-1	Engineering Ethics*	3	ENGR 320Y: Design for a Global Society GS	3
	GA	3	Art GA	3
PH1002-1	Engineering Physics III	3	PHYS 214: General Physics: Wave Motion & Quantum Physics	2
Total Credits	**NMAMIT**	75	**PSU**	**67**

*C-required course

2. **NMAMIT Bachelor of Mechanical Engineering (B.Tech ME) Program to the PSU Bachelor of Science in Mechanical Engineering Technology (MET_BS)**

https://harrisburg.psu.edu/science-engineering-technology/mechanical-engineering- technology-bs

NMAMIT Number	Subject	NMAMIT Credits	PSU Course Equivalent	PSU Credits
MA1009-1	Engineering Mathematics I	4	MATH 140: Calc with Analytical Geometry I	4
CY1001-1	Engineering MA1010-1 Chemistry	3	CHEM 110: Chemical Principles	3
CY1001-1	Engineering Chemistry Lab	1	CHEN 111: Experimental Chemistry	1
CV1003-1	Elements of Civil Engineering and Engineering Mechanics	4	PHYS 211: General Physics: Mechanics	4
ME 1008-1	Computer-aided Engineering Graphics & Practice	3	EDSGN 100: Introduction to Engineering Design	3
HU1506-1	Overview of Indian Culture	3	Humanities GH	3
MA1010-1	Engineering Mathematics II	4	MATH 141: Calc with Analytical Geometry II	4
PH1001-1	Engineering Physics	4	PHYS 212: General Physics: Electricity and Magnetism	4
HU1509-1	Indian Culture-Yakshagana	3	Art GA	3

MG 1507-1	Engineering Economics	3	Social and Behavioral Science GS	3
EE2106-1	Programming for Engineers with MATLAB	3	CMPSC 200: Department-approved elective	3
CV1004-1	Statics	3	EMCH 211: Statics	3
ME1104-1	Thermal Engineering	3	ME 300: Engineering Thermodynamics I	3
HU1508-1	Principles of Physical Education	3	Health and Wellness GHW	3
HU1510-1	Indian Culture - Music	3	Art GA	3
HU1501-1	Elements of Yoga	3	Humanities GH	3
MA2012-1	Matrices	3	MATH 220: Matrices	2
CV1006-1	Study Of Dynamics	3	EMCH 212: Dynamics	3
ME1102-1	Mechanics of Materials	3	EMCH 213: Strength of Materials	3
EE2105-1	Electric Circuits and Power Distribution	3	EE 211: Electric Circuits and Power Distribution	3
MA2011-1	Engineering Mathematics III	4	MATH 251: Department-approved Elective	4
HU1511-1	Engineering Ethics	3	ENGR 320Y: Design for a Global Society	3
Total Credits	**NMAMIT**	**69**	**PSU**	**68**

REGULATIONS
COMMON TO ALL B.Tech. (CBCS) DEGREE PROGRAMS OF NITTE (Deemed to be University)

1. INTRODUCTION

1.1 The general regulations are common to all B.Tech.(CBCS) Degree Programs conducted at the NMAM Institute of Technology (NMAMIT), off-campus center of NITTE (Deemed to be University) and shall be called "B.Tech. Regulations".

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting instructions of courses, the conduct of the examination & evaluation, certification of student performance, and all amendments related to the said Degree program(s).

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the B. Tech Degree program of NITTE (Deemed to be University) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Program(s) (Choice Based Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval. This set of Regulations may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time and shall be binding on all stakeholders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decisions of the Academic Council/ Governing Council shall be final and binding.

1.4 To guarantee fairness and justice to the parties concerned given the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of Engineering courses for appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6 The program shall be called **Bachelor of Technology,** abbreviated as B.Tech. (Program Specialization).

2. ELIGIBILITY FOR ADMISSION

Sl. No	Program	Duration	Eligibility
1	B. Tech.	4 years	Passed 10+2 examination with Physics/ Mathematics / Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject as per Table-1. Obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.
2	B.Tech. (Lateral Entry to Second year)	3 years	Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in relevant branch of Engineering and Technology. (The University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to prepare Level playing field and desired learning outcomes of the program).

Table-1 **Academic Level and Credit Framework for admission to Bachelor of Technology (B.Tech.) degree program**				
Sl. No.	**Academic Level**	**Desired Entry Qualifications at different levels.**	**NHEQF/ NSQF Level at Exit**	**Unified Credit Level (UCF) at Exit**
1	12th Std.	-	4	4
2	First Year B.Tech. Degree	12th Completed (NHEQF /UCF level 4 completed)	5	4.5
3	Second Year B.Tech. Degree	A candidate with a Diploma in the appropriate branch of Engineering/ Equivalent Vocational or Technical Program with NHEQF level 5/UCF level 4.5 completed	6	5

2.1 Qualifications from foreign countries

Candidates with qualifications from educational institutions outside of India may be admitted to the program(s) subject to the establishment of equivalence by the university. The Program Committee will evaluate and establish the eligibility of such candidates.

3. PROGRAM PATHS, EXIT OPTIONS, AND DURATION OF THE B. TECH. PROGRAM

3.1 Program paths, exit options.

Sr. No	Academic Level	Entry Level Qualifications	Qualifications at Exit	NCrF Level
1	1st yr. of UG Degree	A candidate completing 10+2 years with Diploma of Vocation or passed 12th std. or equivalent vocational training with NCrF level 4	**UG Certificate***	4.5
2	2nd yr. of UG Degree	A candidate with Diploma in appropriate branch of Engineering/ UG Certificate/ Equivalent Vocational or Technical Program NCrF level 4.5	**UG Diploma (Engg.) ***	5.0
3	3rd yr. of UG Degree	A candidate with 10+3+1/12+2/ UG Diploma (Engg.) in appropriate domain with NCrF level 5	**B. Sc (Engg.) ***	5.5
4	Final yr. of UG Degree	A candidate with 3 yrears' bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (on completion of 160 credits with a minimum CGPA of 5)**	6
	Final yr. of UG Degree with Honours	A candidate with 3 yrs. Bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (Honors)** 178 credits (Additional 18 credits over and above 160 credits in the same discipline)	6
	Final yr. of UG Degree with a minor in (Other Discipline).	A candidate with 3 yrs. Bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech with Minor** 178 credits. Additional 18 credits over and above 160 credits in other disciplines	6

*** It is mandatory to earn 10 credits through Internship/ Training/ Specialised courses before the award of Qualifications at Exit.**

3.2 Duration of the B. Tech. program

(a) The B. Tech Program shall extend over a period of a total duration of 4 years for students admitted during the first year of the program.

(b) The total duration shall be 3 years for students admitted to the second year under the lateral entry scheme.

(c) The maximum period which a student can take to complete a full-time academic program is eight years / Six years for Lateral entry diploma students for B.Tech.

(d) Each year shall have the following schedule with 5 ½ days a week. Suggested break down of Academic Year into Semesters.

1.	No. of Semesters / Year	There are three semesters in an academic year. Two Main semesters (Odd, Even) followed by a summer semester. Normally the Odd Semester will be from August to December and Even Semester from January to May during a calendar year. The optional summer semester is offered during the vacation period of the even semester. The summer semester is offered considering the demand for such courses of needy students, subject to the availability of time, faculty, and other resources under a fast-track mode as the available instructional days during even semester vacation periods are less. However, the number of instructional hours needed to cover the syllabi shall be maintained (equivalent to that in the regular semester) with a greater number of instruction hours per week. (Note: The summer semester is primarily to assist slow learners and/or failed students in the main semesters. The summer semester may be used to arrange Add-On courses for other students and/or for deputing them for practical training elsewhere)
2.	Semester Duration	Main semester (Odd, Even) each 20 Weeks; Summer Semester 8 Weeks
3.	Academic Activities (Weeks)	**ODD / EVEN Semester** Registration of Courses & Course Work (16) Examination Preparation and Examination (04) Total (20) **Summer Semester** Registration of Courses & Course Work (05) Examination Preparation and Examination (03) Total (08) **Declaration of results:** 02 weeks from the date of the last examination **Inter-Semester Recess:** After each Main Semester (02)

		Total Vacation: 10 weeks (for those who do not register for the summer semester) and 4 weeks (for those who register for the summer semester)

(Note: In each semester, there will be provision for students to register for courses at the beginning, dropping of courses in the middle, and withdraw from courses towards the end, under the advice of a faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and ensuring their better monitoring by Faculty Advisors).

A candidate shall be allowed a maximum duration of eight years from the first semester of admission to become eligible for the award of a Bachelor's degree.

The calendar of events in respect of the program shall be fixed by the Institution from time to time, but preferably in line with the suggested academic calendar of the NITTE (Deemed to be University).

4. DEGREE PROGRAMS

4.1 Undergraduate B. Tech. Degree Programs are offered in the following disciplines by the respective program hosting departments listed below:

i)	Biotechnology Engineering	(BT)
ii)	Computer Science & Engineering	(CS)
iii)	Computer Science & Engineering (Cyber Security)	(CB)
iv)	Civil Engineering	(CV)
v)	Electronics & Communication Engineering	(EC)
vi)	Electronics Engineering (VLSI Design and Technology)	(VT)
vii)	Electronics & Communication (Advanced Communication Technology)	(AC)
viii)	Electrical & Electronics Engineering	(EE)
ix)	Information Science & Engineering	(IS)
x)	Mechanical Engineering	(ME)
xi)	Artificial Intelligence and Machine Learning Engineering	(AM)
xii)	Computer and Communication Engineering	(CC)
xiii)	Robotics and Artificial Intelligence Engineering	(RI)
xiv)	Artificial Intelligence and Data Science	(AD)
Other teaching departments are –		
i)	Chemistry	(CY)
ii)	Humanities	(HU)
iii)	Management and Social Sciences	(MG)
iv)	Mathematics	(MA)
v)	Physics	(PH)

4.2 The provisions of these regulations shall apply to any new discipline that may be introduced from time to time and appended to the above list.

5. CREDIT SYSTEM

In the Credit System, the course work of students is unitized, and each unit is assigned one credit after a student completes the teaching-learning process as prescribed for that unit and is successful in its assessment.

5.1 Credit Definition: The following widely accepted definition for credit can provide good flexibility to the students and strengthens CBCS under the University. Here, one unit of course work and its corresponding one credit (while referring to the main semester) shall be equal to:

- Four-credit theory courses shall be designed for 50 hours of the Teaching-Learning process.
- Three-credit theory courses shall be designed for 40 hours of the Teaching-Learning process.
- Two-credit theory courses shall be designed for 25 hours of the Teaching-Learning process.
- One credit theory course shall be designed for 15 hours of the Teaching-Learning process.

The above figures shall also be applicable in the case of the summer semester. Other student activities which are not demanding intellectually, or which do not lend to effective assessment, like practical training, study tours, and attending guest lectures shall not carry any credit.

5.2 Credit Assignment and Lower & Upper Limits for Course Credits Registration in a Semester

All courses comprise of specific Lecture/Tutorial/Practical/Project (L-T-P-J) schedule. The course credits are fixed based on the following norms.

Lecture / Tutorials / Practical:

- 1-hour Lecture per week is assigned 1.0 Credit.
- 2-hour Tutorial session per week is assigned 1.0 Credit.
- 2-hour Lab. Session/project work per week is assigned 1.0 credit.
  For example,
- A theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.
- A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.
- Calculation of Contact Hours / Week – A Typical Example

  Example:

  An L-T-P-C of 2-2-2-4 means 2 instructional units based on classroom lecture (L), one instructional unit of the tutorial (T), and one laboratory (P) based instructional unit all delivered during a calendar week and repeated for the entire duration of the semester to earn 4 credits (C) after passing the course.
- As advised by the faculty advisor, a student may register, between a minimum of **16 credits and up to a maximum of 28 credits.**

  The maximum number of credits a student can register during a summer semester shall be 16. However, in special cases, the student may be permitted to register additional credits with the approval of the Department Undergraduate Committee (DUGC). There is no minimum number of credits fixed for course registration during the summer semester.

6. REGISTRATION

6.1 Every student after consulting his/ her Faculty Advisor in the parent department shall register for the approved courses (core and elective) to earn credits for meeting the requirements of a degree program at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar. Students who fail to register on or before the specified date will be allowed to register within one week of the last date by paying a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the University at the end of each semester, like ODD, EVEN, and summer and it forms the basis for determining the student's performance in that semester.

i) Each course will be identified by a unique Course Code of seven alpha-numerals (two alphabets followed by 5 digits). The alphabets reflect the discipline to which the course belongs. The first numeral (after the alphabet) indicates the learning level (based on prerequisites) of the course, and the rest of the three numerals indicate a running serial number. Each course also has its version to track the revisions carried out in its syllabus over time as represented by the last numerical separated by a hyphen (-). Example: EE1001-1 represents the course offered by EE Dept., Level-1, course serial number is 001 and the version is 1.

6.2 Mandatory Pre-Registration for higher semester

To facilitate proper planning of the academic activities of the Semester, the students must declare their intention to register for courses of higher semesters (3rd and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Department Notice Board at least 4 weeks before the last working day of the semester.

Registration to a higher semester is allowed only if the student fulfills the following conditions.

- Satisfied all the academic requirements to continue with the program of studies.
- Cleared all Institute, hostel, and library dues and fines, if any, of the previous semester.
- Paid all required fees of the Institute and the hostel for the current semester.
- Has not been debarred from registering on any specific grounds by the Institute.

6.3 Registering for Backlog Courses

i) Students who have not cleared a course (Theory/ Lab/ project) are shown with "F" grade. A course having an 'F' grade will be considered as a backlog and it has to be re-registered in the subsequent semesters. F-graded courses are eligible to register for the next level course (pre-requisite is met).

ii) Re-registration fee will be as per the university norms existing at the time of re-registration. When a course is re-registered, the evaluation marks of that course shall be treated as canceled/ reset.

iii) To provide an early opportunity for students to clear their backlog of courses, efforts will be made to offer as many courses as possible during Odd, Even and summer semesters.

7. ADD/DROP/AUDIT OPTIONS

7.1 Registration of courses

Each student shall have to register for course work at the beginning of a semester within 2 to 3 days of commencement after discussing with the course teacher and under faculty advice. The permissible course load is to be either average credits (20) or to be within the limits of minimum (16) and maximum (28) credits.

7.2 DROP-option

During a specified period in the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following a poor performance by a student, he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses are to be re-registered by these students and taken up for study at a later point in time.

7.3 Withdrawal from courses (Letter Grade "W")

During a specific period specified towards the end of the semester, a student's performance in CIE is reviewed by the faculty advisors. Following a poor performance by a student in the identified course (s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with a mention in the Grade card (Grade "W"). Such courses to be re-registered by these students and taken up for study at a later point in time.

7.4 AUDIT-option (Letter Grade "U")

A student can register for courses for audit only, to supplement his/her knowledge and/or skills. The audit courses shall not be considered in determining the student's academic performance (SGPA and CGPA) in the semester. "U" grade is awarded to such courses and will be reflected in the grade card on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses. However, CORE courses shall not be made available for audit.

8. COURSE STRUCTURE:

8.1 Types of courses

A "Course" is defined as a unit of learning that typically lasts one semester, led by one or more teachers, for a fixed roster of students. A course has identified course outcomes, modules/units of study, specified teaching-learning methods, and assessment schemes. A course may be designed to include lectures, tutorials, practical, laboratory work, field work, project work, internship experiences, seminars, self-study components, online learning modules, etc. in any combination.

The following types of courses are included in the B. Tech. program:

(a) **Humanities, Social Sciences, and Management Courses (HSMC):** These are common courses for all disciplines.

(b) **Basic Science Courses (BSC):** Physics, Chemistry, and Mathematics: These are mandatory for all disciplines.

(c) **Engineering Science Courses (ESC):** Basics of Electrical/ Electronics/ Civil/ Mechanical/ Computer Engineering, etc. These are mandatory for all disciplines.

(e) **Professional Core Courses (PCC):** These are the professional Core Courses, relevant to the chosen specialization/ branch. The core courses shall be compulsorily studied by students, and it is mandatory to complete them to fulfill the requirements of a Program.

(f) **Professional Elective Courses (PEC):** These are professional Electives, relevant to the chosen specialization/branch and can be chosen from the pool of courses. It shall be supportive to the discipline providing extended scope/enabling exposure to some other discipline /domain and nurturing student proficiency skills.

(g) **Open Elective Courses (OEC):** These are the Elective Courses from other technical areas and/ or emerging fields. Students of other departments shall opt for these courses for fulfilling the eligibility and prerequisites mentioned in the syllabus.

(h) **Integrated Professional Core Courses (IPCC):** It refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC shall be 04 considering L: T: P as 3:0:1 or L: T:P as 2:1:1, (where L, T, and P represent credits not hours per week)

(i) **Holistic Education Courses (HEC):** These courses are designed to look into the emotional, social, ethical and academic needs of students in an integrated learning format. It helps in the engagement of all aspects of the learner including body, mind and spirit.

(j) **Vocational Education Courses (VEC):** These courses are designed to prepare students for jobs that are based on manual or practical activities, traditionally non-academic related to a specific trade, occupation or vocation.

(k) **Emerging Technology Courses (ETC):** These courses are designed to teach students about developing technologies that will be available within the next five to ten years and are expected to create significant social or economic effects.

(l) **Programming Language Courses (PLC):** These courses are designed to teach students languages that can be used to communicate with computers for developing and working on different applications.

(m) **University Core Courses (UCC): These are compulsory core courses with common course codes across all the disciplines.**

i. **Project Work (PROJ):** Provide experiential learning opportunities for students. Students are required individually, or in a small group, to select and complete a project that may include review, design, development, curation, analysis, etc. with the application of skills and knowledge relevant to the area of study. Mini-project and Project work carried out at the parent Institution, or any university / Government recognized organization without affecting the regular class work.

ii. **Internship (INT):** The internship (a form of experimental learning) program is a workplace-based professional learning experience that offers supervised exposure to real-life work experience in an area related to the field of study or career interest. An internship may be undertaken at a workplace such as an industry/R&D organization/Government organization, or any other reputed organization/ institution recognized for the purpose by the University. The internship program not only helps fresh pass-outs in gaining professional know-how but also benefits corporate sectors. The internship also enhances the employability skills of the student passing out from Technical Institutions.

(n) **Mandatory Non-Credit Courses (MNC):** These courses are mandatory, without the benefit of a grade or credit, passing each mandatory course is required to qualify for the award of a degree.

- Assessment of these courses is conducted in the college and will include Continuous Internal Evaluation (CIE). University Semester End Evaluation (SEE) may not be necessary for these courses.
- A minimum of 40% of the prescribed marks of CIE and SEE (If any) are required to secure a passing grade in these courses.
- The 'PP' grade is awarded for a Pass in the course and the 'NP' grade is awarded for a Fail in the course. In case an 'NP' grade is awarded, the student has to re-register for the same course wherein he has no alternative options.
- The "PP" and "NP" grades do not carry grade points and are hence not included in the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) computations. However, such non-credit mandatory courses are required to be included in the students' performance records (transcript) with Pass or Fail (PP or NP).
- Courses that come under this category are the following.

Employability Skill Development, Environmental Science, Kannada etc.

(o) **Ability Enhancement Courses (AEC):** These courses are designed to help students to enhance their skills in language, communication, personality development, etc. They also promote a deeper understanding of courses like social sciences, ethics, culture, human behavior human rights, and the law. Ability Enhancement Courses are based upon the content that leads to knowledge enhancement.

8.2 Typical Breakdown for the B.Tech. Degree Curriculum:

Sl. No.	Course Category	Credit Range	Suggested Credits
1.	Basic Science Courses (BSC)	18-23	22
2.	Engineering Science Courses (ESC)	10-15	13
3.	Emerging Technology Courses (ETC)	03-05	03
4.	Programming Language Courses (PLC)	03-05	03
5.	Professional Core Courses (PCC)	52 - 58	55
6.	Professional Elective Courses (PEC)	12-18	15
7.	Open Elective Courses (OEC)	6	6
8.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
9.	Ability Enhancement Courses (AEC)	9	9
10.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
11.	Holistic Education Courses (HEC)	2	1
12.	Vocational Education Courses (VEC)	1	1
13.	Project Work (PROJ) (UCC)	10-12	10
14.	Internship (INT) (UCC)	8-12	10
15.	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

i) The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the program for the above components, the semester-wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

8.3 The earned Credit Requirements for the B.Tech. Degree is 160.

Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to a student to plan their career.

8.4 Program structure and suggested Course offerings

I/II SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**			**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/Drawing**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**					
1	BSC	MA1005 – 1	Matrix Algebra and Differential Equations	MAT	3	0	0	3	50	50	100	3
2	BSC	CY1006-1	Chemistry of Engineering Materials	CHE	3	0	2	3	50	50	100	4
3	ESC	ME1003-2	Elements of Mechanical Engineering	ME	3	0	0	3	50	50	100	3
4	ESC	EE1002-1	Basic Electrical and Electronics Engineering	EE	3	0	0	3	50	50	100	3
5	ETC	ME1008-1	Introduction to Internet of Things (IoT)	ME	3	0	0	3	50	50	100	3
6	AEC	CS1002-1	IT Skills	Any Dept.	1	0	2	3	50	50	100	2
7	ESC	ME1001-1	Engineering Skill Development Practice	ME	0	0	2	2	50	50	100	1
8	AEC	BT1651-1	Biology for Engineers	BT	1	0	0	1	50	50	100	1
9	MNC	CV1002-1	Environmental Studies	CV	1	0	0	1	50	0	50	0
				TOTAL	**18**	**0**	**6**	**22**	**450**	**400**	**850**	**20**

Mandatory Internship-I*								
10	INT	UC1001-1	Internship – I	Mandatory Intra Institutional Internship of duration (80 - 90 Hours) to be completed during I & II Semesters. *The grades will be included in the IV semester grade card (Refer 11.5.2 for details)	100	--	100	2

I/II SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**			**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**					
1.	BSC	MA1008 – 1	Calculus and Laplace Transforms	MAT	4	0	0	3	50	50	100	4
2.	BSC	PH1007-1	Physics of Materials	PHY	3	0	2	3	50	50	100	4
3.	ESC	ME1002-1	Computer Aided Engineering Graphics	ME	2	0	2	3	50	50	100	3
4.	ESC	CV1003-1	Engineering Mechanics	CV	3	0	0	3	50	50	100	3
5.	PLC	CS1005-1	Introduction to Python Programming	ME	2	0	2	3	50	50	100	3
6.	HSMC	HU1001-1	Technical English	HU	1	0	2	3	50	50	100	2

7.	MNC	HU1002-1	Constitution of India	HU	1	0	0	1	50	0	50	0
8.	BSC	MA1006 - 1	Mathematics with MATLAB	MAT	0	0	2	1	50	0	100	1
			TOTAL		**16**	**0**	**8**	**20**	**400**	**300**	**750**	**20**

III SEMESTER														
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**					**Credits**
					Theory Lecture	**Tutorial**	**Practical/Drawing**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**		
					L	**T**	**P**	**J**						
1	BSC	MA2003-1	Vector Calculus & Complex Functions	MA	3	0	0	0	03	50	50	100		3
2	IPCC	ME1006-1	Manufacturing Processes	ME	3	0	2	0	03	50	50	100		4
3	IPCC	ME1007-1	Material Science and Engineering	ME	3	0	2	0	03	50	50	100		4
4	PCC	ME1102-1	Mechanics of Materials	ME	3	0	0	0	03	50	50	100		3
5	PCC	ME1104-1	Thermal Engineering	ME	3	0	0	√	03	50	50	100		3
6	PCC	ME2602-1	**Manufacturing & Machine Graphics & Drawings**	ME	0	0	2	0	03	50	50	100		1
7	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	03	50	50	100		2
8	MNC	HU1003-1	Kannada (Balake / Samskrithika)	Any Dept.	1	0	0	0	-	50	-	50		0
9	HEC	HU1005-1	Essence of Indian Culture	Any Dept.	1	0	0	0	-	50	-	50		0
TOTAL					**19**	**0**	**6**	**-**	**21**	**450**	**350**	**800**		**20**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
10	MNC	MA1011 - 1	Bridge Course – Calculus and Laplace Transforms	MA	3	0	0	0	3	100	0	100	0

IV SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical /Drawin**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1	BSC	MA2014-1	Probability Theory & Computational Mathematics	MA	3	0	0	0	03	50	50	100	3
2	IPCC	ME2003-1	**Technology and processes in Heavy Manufacturing**	ME	3	0	2	0	03	50	50	100	4
3	IPCC	ME1005-1	Fluid Mechanics & Machinery	ME	3	0	2	0	03	50	50	100	4
4	PCC	ME1103-1	Theory of Machines	ME	3	0	0	0	03	50	50	100	3
5	PCC	ME1101-1	Engineering Metrology	ME	3	0	0	√	03	50	50	100	3
6	PCC (Lab)	ME2605-1	Metrology & Measurements Lab (Lab course)	ME	0	0	2	0	03	50	50	100	1
7	HSMC	HU1004-1	Universal Human Values	Any Dept.	1	0	0	0	01	50	50	100	1
8	AEC	ME1654-1	Innovations and Design Thinking	ME	1	0	0	0	01	50	50	100	1
9	VEC	ME1551-1	Department specific Vocational Education Course (PRACTICAL WELDING TECHNOLOGY)	ME	0	0	2	0	03	50	50	100	1
10	UCC	UC1001-1	Internship – I (Activity based Internship)	ME	Mandatory Intra Institutional Activity based Internship of 2 weeks duration (80 - 90 h) to be completed during the vacations of I & II Semesters. Lateral entry students have to complete the Internship - I during the vacation of III semester					100	-	100	2
TOTAL					**17**	**0**	**8**	**-**	**23**	**550**	**450**	**1000**	**23**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
11	MNC	MA1013-1	Bridge Course – Probability and Differential Equations	MA	3	0	0	0	3	100	0	100	0

V SEMESTER														
Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	IPCC	ME2001-1	Automotive Engineering	ME	3	0	2	0	3	50	50	100	4
2	IPCC	ME3001-1	Finite Element Methods	ME	3	0	2	0	3	50	50	100	4
3	PCC	ME2104-1	**Mechatronics System in Manufacturing**	ME	3	0	0	0	3	50	50	100	3
4	PCC (Lab)	ME2604-1	Energy Conversion Lab	ME	0	0	2	0	3	50	50	100	1
5	PEC	MEXXXX-1	Professional Elective-I [Group-1] **Digital Technologies including CPS, IIOT & Cloud in Manufacturing**	ME	3	0	0	0	3	50	50	100	3
6	HSMC	HU1006-1	Introduction to IPR	Any Dept.	1	0	0	0	1	50	50	100	1
7	AEC	MEx6xx-1	Program Specific Ability Enhancement Course	ME	1	0	2	0	3	50	50	100	2
		HU1010-1	Research Methodology	Any Dept.	2	0	0	0					
8	AEC	HU1007-1	Social Connect & Responsibility	Any Dept.	1	0	0	0	1	50	50	100	1
9	AEC	UM1003-1	Employability Skill Development	ME	1	0	0	0	-	50	-	50	1
TOTAL					**16/17**	**0**	**8/6**	**-**	**20**	**450**	**400**	**850**	**20**

VI SEMESTER														
Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawin	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	IPCC	ME3002-1	Heat Transfer	ME	3	0	2	0	3	50	50	100	4
2	PCC	ME3100-1	Design of Machine Elements	ME	3	0	0	0	3	50	50	100	3
3	PCC (Lab)	ME2601-1	CNC Lab	ME	0	0	2	0	3	50	50	100	1
4	PEC	MEXXXX-1	Professional Elective - II [Group-1]	ME	3	0	0	0	3	50	50	100	3

5	PEC	MEXXXX-1	Professional Elective - III [Group-2] **Additive Manufacturing**	ME	3	0	0	0	3	50	50	100	3
6	OEC	XXX5XX-1	Open Elective –I	Any Dept.	3	0	0	0	3	50	50	100	3
7	HSMC	MG1006-1	**Project Management For Professionals**	Any Dept.	3	0	0	0	3	50	50	100	3
8	AEC	HU1008-1	Life Skills For Engineers	Any Dept.	1	0	0	0	1	50	50	100	1
TOTAL					**19**	**0**	**4**	**-**	**22**	**400**	**400**	**800**	**21**

*** A MNC on Entrepreneurship will be offered with one hour per week with only CIE component.**

VII SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practica l/Drawi**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1	IPCC	ME2002-1	**Collaborative Robotics in Manufacturing Aided by AI, ML & IIOT**	ME	3	0	2	0	3	50	50	100	4
2	PCC (Lab)	ME2603-1	Dynamics Lab	ME	0	0	2	0	3	50	50	100	1
3	PEC	MEXXXX-1	Professional Elective – IV [Group-1]	ME	3	0	0	0	3	50	50	100	3
4	PEC	MEXXXX-1	Professional Elective – V [Group-2]	ME	3	0	0	0	3	50	50	100	3
5	OEC	XXX5XX-1	Open Elective –II	Any Dept.	3	0	0	0	3	50	50	100	3
6	HSMC	MG1009-1	Engineering Economics & Financial Management	ME	3	0	0	0	3	50	50	100	3
7	HEC	HU1009-1	Indian Knowledge Systems	Any Dept.	1	0	0	0	-	50	-	50	1
8	UCC	UC3001-1	Major Project Phase I	ME	-	-	4	-	-	100	-	100	2
TOTAL					**16**	**0**	**8**	**-**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER													
Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	UCC	UC2001-1	Internship- II (Societal internship and Research/Industry Internship)		Mandatory Societal internship for 2 weeks (80 – 90 h) and Research Internship / Industry Internship of 6 weeks (240 – 270 h) or Research Internship / Industry internship for a total of 8 weeks (320 – 360 h) to be completed in one/ two stretches during the vacation periods between IV to VII semesters				3	50	50	100	8
2	UCC	UC3002-1	Major Project Phase II		Student should carry out project in research institute/ industry/ intra institute Canter of Excellences. Two contact hours /week for interaction between the project guide and students.				3	100	100	200	8
TOTAL					-	-	-	-	**6**	**150**	**150**	**300**	**16**

8.5 Eligibility for submission of Project Work Report

i) Project work during the 8th semester shall be taken up batch-wise and report can be submitted for evaluation only on completion of a minimum of 122 credits and for Diploma lateral entry students (those who have joined the second year B.Tech.) the same is **88 credits**.

ii) Project work can be carried out as domain-specific /interdisciplinary under the guidance of faculty/ faculty members. They can also opt for an advanced Internship or research Internship in an Industry / Research Institution/Center of excellence.

iii) Project viva-voce examination shall be conducted individually.

8.6 ELECTIVES

i) A candidate shall take electives in each semester from groups of electives, commencing from the 5th semester.

ii) The minimum number of students to be registered for any Elective offered shall not be less than fifteen (15) and should not exceed forty (40).

iii) A candidate shall opt for his/her choice of electives and register for the same at the beginning of each of the 5th to 7th semesters if pre-registration is not done. The candidate is permitted to opt for a change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

9. ATTENDANCE REQUIREMENT:

9.1 Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by the principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops, and paper presentation.

9.2 The basis for the calculation of the attendance shall be the term prescribed by the institution by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course.

9.3 The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up for the shortage.

9.4 A candidate having a shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s). Such students will be awarded an **'N' grade** in these courses.

9.5 He/she shall have to repeat those course(s) with an 'N' grade and shall re-register for the same course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or summer semester.

9.6 **Attendance in CIE and SEE:** Attendance in all examinations both CIE and SEE of each course registered shall be compulsory and there shall not be any provision for re-examinations. Any student against whom any disciplinary action is pending shall not be permitted to attend any SEE in that semester.

10. WITHDRAWAL FROM THE PROGRAM

10.1 Temporary Withdrawal

a) A student who has been admitted to a degree program of the college may be permitted once during the course to withdraw temporarily, for one semester, on the grounds of prolonged illness or grave calamity in the family, etc., provided –

   i. The student applies to the College within 6 weeks of the commencement of the college stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian.

   ii. The College is satisfied with the genuineness of the case and that even by considering the expected period of withdrawal, the student can complete the program requirements (160 credits) within the time limits specified by the university.

   iii. The student does not have any dues or demands at the College / University including tuition and other fees as well as library material.

   iv. A student availing of temporary withdrawal shall be required to pay such fees and/or charges as may be fixed by the college until his/her name appears on the student's roll list. The fees/charges once paid shall not be refunded.

   v. A student will be entitled to avail of the temporary withdrawal facility only once during his/her studentship. However, any other concession for the concerned student shall have to be approved by the academic council.

10.2 Permanent Withdrawal

Any student who withdraws the admission before the closing date of admission for the

Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions.

i) A student who wants to leave the College for good will be permitted to do so (and take a Transfer Certificate from the College, if needed), only after clearing all other dues if any.

ii) Those students who have received any scholarship, stipend, or other forms of assistance from the College shall repay all such amounts.

iii) The decision of the Principal of the College regarding the withdrawal of a student is final and binding.

11. EVALUATION SYSTEM

11.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.

11.2 The Letter grades O, A+, A, B+, B, C, P, and F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

11.3 The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments, etc., as applicable, in addition to two mid-semester examinations and one semester-end examination. The distribution of weightage among these components may be as follows.

Semester End Examination (SEE)		:	50% (50 marks)
Continuous Internal Evaluation (CIE)		:	50% (50 marks)
CIE for Non-PBL Courses			
i)	Quizzes, Tutorials, Assignments, Seminars, etc.	:	10 marks
ii)	Mid-semester Examinations	:	40 marks
CIE for PBL/IPCC Courses			
i)	Project Based Learning (PBL)	:	50 marks
ii)	Mid-semester Examinations	:	40 marks
iii)	Quizzes, Tutorials, Assignments, Seminars, etc.	:	10 marks
60% weightage for theory + 40% weightage for PBL/Practical			

Any variation, other than the above distribution, requires the approval of the pertinent DUGC and Academic Council.

11.4 The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC and the performance in SEE held on the specified period in a semester.

11.5 **Evaluation Scheme** *(Refer to Appendix-B for detailed evaluation guidelines)*: The course Instructor shall announce in the class and/or display at the Notice board/faculty door/website the details of the Evaluation Scheme, including the distribution of the weightage for each of the components and method of conversion from the raw scores to the letter-grades within the first week of the semester in which the course is offered so that there are no ambiguities in communicating the same to all the students concerned.

i) **Internship:** Mandatory Internship is in two parts. Internship-I (2 weeks) and Internship-II (8 weeks)

ii) **Internship-I**

- All the students admitted to the 1st semester of engineering programs shall have to undergo Internship-I of 02 weeks (or 80 to 90 hrs duration) during the first year. The internship shall include Inter / Intra Institutional activities. A viva – voce examination (Presentation followed by question-answer session) shall be conducted during the 2nd semester (for lateral entry students, during the 3rd semester) and the prescribed credit shall be included in the 4th-semester grade card.
- All the students admitted to the 3rd semester of Engineering programs (Lateral Entry Category) shall have to undergo a mandatory internship of 02 weeks (during the 3rd semester or the intervening period of the 3rd and 4th semesters). The internship shall include Inter/Intra Institutional activities.
- The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up / complete the internship shall be declared to fail and shall have to complete it during subsequent University examinations after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the student's internship progress and interact to guide them for the successful completion of the internship).
- **Procedure for the Evaluation of Internship-I**
  a) Students should submit the reports immediately on completion of the Internship to the respective mentors.
  b) The Examination of the internship will be carried out by the mentor.
  c) The Internship-I shall be slated for 100 marks CIE only and will not have SEE.
  d) Internship-I marks are based on CIE marks (25 marks for the first presentation, 25 marks for the second presentation, and 50 marks for the report and final presentation).
  e) A Viva-Voce examination is conducted during I/II/III Semesters (Presentation followed by question-answer session) and the prescribed credit shall be included in the IV semester grade card.

iii) **Internship-II**

- All the students admitted to engineering programs shall have to undergo Internship-II of 08 weeks during the second and third year of their Engineering studies.
- During the intervening period of the IV & V semesters and VI & VII semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo 8 weeks Internship involving Innovation / Entrepreneurship/ or short-term (about 2 weeks) societal-related activities and 6 weeks Industry Internship.

iv) **Project work evaluation:** The evaluation of CIE of the project work shall be based on the progress of the student in the work assigned by the project supervisor, periodically evaluated by him/her together with a department committee constituted for this purpose. Seminar presentation, project report, and final oral examination conducted by the project evaluation committee at the department level shall form the SEE of the project work.

v) In the case of other requirements, such as seminar, field work, or comprehensive viva voce, if any, the assessment shall be made as laid down by the DUGC/Academic council.

vi) There shall be no re-examination for any course in the credit system.

However, students

- who have abstained from attending CIE or SEE without valid reasons (“N” grade), or
- who have failed (F grade) to meet the minimum passing standards prescribed for CIE and/or SEE or
- who have been detained for shortage of attendance or who have withdrawn (W grade) who have dropped any course shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than “P” Grade in each case.
- While such students should re-register for the same course(s) if core, they can re-register for the alternative course(s) from among the elective courses, as the case may be. The re-registration shall be possible when the particular course is offered again either in a main (Odd/Even) or summer semester.

11.6 Qualifying standards

Evaluation Method	Qualifying Standard
Sessional (CIE)	Score: ≥40% (≥20 marks)
Terminal (SEE)	Score: ≥40% (≥20 marks)
For securing a final Pass	Total **40 % of the Course maximum marks (100)** i.e., the sum of the CIE and SEE marks prescribed for the Course is desired.

11.7 Grading System

The letter grade awarded to a student for his/her performance in a course is based on Absolute Grading.

i) Absolute Grading – Letter Grade and its range
The grade point scale for absolute grading

Marks Range (%)	Grade Point	Letter Grade	Descriptor
90 & above	10	O	Outstanding
80-89	9	A+	Excellent
70-79	8	A	Very Good
60-69	7	B+	Good
55-59	6	B	Above Average
50-54	5	C	Average
40-49	4	P	Pass
00-39	0	F	Fails
Absent	0	AB	Absent

CGPA	Classification
7.00-& above	**First Class with Distinction**
6.00-6.99	**First Class**
5.00-5.99	**Second Class**
CGPA < 5.00*	**Academic Probation / Non-compliance**

***** If a student secures CGPA< 5.0 at any point time during his/her studies, he/she will be on Academic Probation/Noncompliance (refer to sections 14.2 and 17.3 for more details.)

i) **Grade "N":** A candidate having a shortage of attendance (<75%) in any course(s) or CIE marks less than 40% shall not be allowed to appear for SEE of such course(s). Such students will be awarded an 'N' grade in these courses with a grade point of 0.

ii) The grade points are given above help in the evaluation of credit points earned by the student in a course as the credit points are equal to the number of credits assigned to the course multiplied by the grade points awarded to the student in that course. This shall be used in Arriving at the credit index of the student for that semester, as it is the total of all the credit points earned by the student for all the courses registered in that semester.

11.8 Earning of Credits

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range of O-P. The letter grade "F" in any course implies the failure of the student in that course and no credits earned.

i) The Transitional Grades "I", "W" and "X" would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (O-F) after the student completes the course requirements.

ii) **Grade "I"**: To a student having attendance ≥85% and CIE ≥70%, in a course, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:

a) Illness or accident, which disabled him/her from attending SEE.

b) A calamity in the family at the time of SEE required the student to be away from the College.

c) However, the committee chaired by the Principal is authorized to relax the requirement of CIE ≥ 70% if the student is hospitalized or advised long-term rest after discharge from the hospital by the Doctor.

d) Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Makeup Examinations within 2 working days of that examination for which he or she is absent, failing which they will not be given permission.

iii) **Grade “W”:** To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice

iv) **Grade “X”:** To a student having attendance ≥85% and CIE ≥70%, in a course but SEE performance could result in an F grade in the course. **(No “F” grade will be awarded in this case, but the student’s performance record is maintained separately).**

11.9 Summer / Fast Track semester

i) The students who have satisfied CIE and Attendance requirements for the course/s and obtained an F grade in SEE are permitted to appear directly in ensuing examination/s as backlog paper/s. The students need not re-register for such course/s in the summer / fast track semester. In case the student wishes to improve CIE/ he/she has to re-register for the summer / regular semester as and when offered next.

ii) The student who obtains required attendance and CIE in the summer semester, but obtains an 'F' grade in SEE; is permitted to appear for SEE subsequently as backlog course/s. The student need not repeat the course for Attendance and CIE.

iii) The course/s for which the student does not possess satisfactory attendance and CIE score shall be marked as ‘N’ on the Grade sheet. Such students are not permitted to SEE for the Courses marked as ‘N’ on the Grade sheet. The students have to re-register only for course/s marked as ‘N’ in the summer/ subsequent semester whenever that course is offered and obtain the required CIE and attendance. Subsequently, they are eligible to appear for SEE in such course/s.

iv) Courses with Transitional Grades viz "W”, "I", and "X" are also eligible to register in the summer semester in case they wish to improve their score in CIE.

v) All courses may not be offered in the summer semester. It is the discretion of the University to offer the courses based on the availability of resources. The Institutes shall notify timetable for the summer semester well in advance.

vi) Summer Semester is optional; it is for the student to make the best use of the opportunity.

vii) A student is permitted to register for a maximum of 16 credits in the Summer / fast track semester.

viii) A student has to choose those courses which are offered by the Institution in a given summer Semester.

ix) In the summer semester, each course needs to be offered for the required number of lectures/ tutorial/ laboratory hours as prescribed in the syllabus.

11.10 Grade Card

Each student shall be issued a Grade Card at the end of each semester. This will have a list of all the courses registered by a student in the semester, together with their credits, the letter grades with grade points awarded. Only those courses registered for credit and having grade points shall be included in the computation of the students' performance like SGPA and CGPA and the courses are taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type shall also be reflected in the Grade card as PP (for Passed) or NP (for not passed). **Each UG student shall have to obtain the grade PP in each mandatory course to qualify for the Degree awarded by the university.**

11.11 Re-evaluation and paper seeing.

Re-evaluation is permitted only for theory papers. The University, on receiving application within the stipulated time and remittance of a prescribed fee for re-evaluation, shall permit re-evaluation for the course/s applied. The marks obtained after re-evaluation shall be the final marks awarded.

11.12 The Make-Up Examination

The Make-Up Examination facility would be available to students who may have missed attending the SEE of one or more course(s) in a semester for valid reasons and given the "I" grade; Also, students having the "X" grade shall be eligible to take advantage of this facility. **The makeup examination would be held as per dates notified in the Academic Calendar during the summer semester.** However, it would be possible to hold a makeup examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of makeup examinations shall be the same as the regular SEE for the course(s).

a) All the "I" and "X" grades awarded to the students would be converted to appropriate letter grades after the make-up examinations. Any outstanding "I" and "X" grades after the last scheduled make-up examinations shall be automatically converted to "F" grades.
b) All the "W" grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ Summer semester and fulfill the passing standards for their CIE and (CIE+SEE).

11.13 Rules for grace marks

i) Grace marks up to 1% of the maximum total marks of the courses for which he/she is eligible and have registered (non-credit courses excluded) in the examination or 10 marks whichever is less shall be awarded to the failed course(s), (with a restriction of a maximum of 5 marks per course) provided on the award of such grace marks the candidate passes in that course(s).

12. EVALUATION OF PERFORMANCE

The overall performance of a student will be indicated by two indices:
SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.
SGPA for a semester is computed as follows.

$$SGPA = \frac{\sum[(Course\ Credits) \times (Grade\ Point)] \text{ (for all courses in that semester)}}{\sum[Course\ Credits]}$$

CGPA is computed as follows:

$$CGPA = \frac{\sum[(Course\ Credits) \times (Grade\ Point)] \text{ (for all courses excluding those with F grades until that semester)}}{\sum[Course\ Credits] \text{ (for all courses excluding those with F grades until that semester)}}$$

13. COMMUNICATION OF GRADES

The SGPA and CGPA respectively, facilitates the declaration of academic performance of a student at the end of a semester and the end of successive semesters. Both would be normally calculated to the second decimal position.

14. REQUIREMENTS FOR VERTICAL PROGRESSION
(PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

14.1 All students are promoted to the next semester or year of their program, irrespective of their academic performance.

14.2 However, at any stage of his/her study, if a student reaches a CGPA below 5.00, the student will be on **Academic Probation** and is permitted to register for a maximum of 16 credits in subsequent semesters, until his CGPA crosses 5.0. However, the student has the choice to re-register for the courses/courses in which he/she has obtained an 'F' / 'N' grade.

14.3 A Student shall be declared fail if he/she

(i) Has not satisfied the CIE requirements of any Course/s.

(ii) Has not appeared for the SEE even after satisfying the attendance and CIE requirements.

14.4 Vertical Progression for regular students who have taken admission to the first year: Normally a student is expected to complete a minimum of 85% of credits by the end of the 7th semester. However, **for submission of B.Tech. Major Project in 8th semester, the student should have completed at least 122 credits.**

14.5 Vertical Progression in case of Diploma students admitted to Second year (lateral entry):

i) Lateral entry students should complete at least 85% of credits by the end of the 7^{th} semester. However, for **submission of B.Tech. Major Project in 8^{th} semester, the student should have completed at least 88 credits.**

ii) Diploma students should register for mandatory non-credit Mathematics Courses Bridge Courses (i) Calculus and Laplace Transforms and (ii) Probability and Differential Equations prescribed during III and IV semesters respectively. They shall attend these bridge course classes during the respective semesters to satisfy attendance and CIE requirements.

iii) Completion of Mathematics Courses Bridge Courses (i) Calculus and Laplace Transforms and (ii) Probability and Differential Equations shall be mandatory for the award of the degree.

14.6 Termination from the program

A student shall be required to withdraw (discontinue) from the program and leave the college on the following grounds.

i) Failure to secure a minimum CGPA of 5.0 at the end of 8 years (6 years for lateral entry students).

ii) Failure to earn 160 credits (120 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).

iii) Absence from classes for more than **six weeks at a time** in a semester without leave of absence being granted by competent authorities.

iv) Failure to meet the standards of discipline as prescribed by the college from time to time.

15. AWARD OF CLASS

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or classes awarded as in the conventional system of declaring the results of university examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class. This can be seen in the following Table.

Percentage Equivalence of Grade Points (For a 10-Point Scale)

Grade Point	Percentage of Marks*	Class
$\geq$ 7.00	$\geq$ 70%	First class with Distinction
$\geq$ 6.00	$\geq$ 60%	First Class
5.0 $\geq$ CGPA <6.00	50$\geq$ Percentage < 60%	Second Class

Percentage * = (CGPA) x 10

16. APPEAL FOR REVIEW OF GRADES

a. The entire process of evaluation shall be made transparent, and the course instructor shall explain to a student why he/she gets whatever grade he/she is awarded, if and when required. A mechanism for the review of grades is incorporated into the evaluation system. However, before appealing for such review, a student shall first approach the concerned course Instructor and then the concerned DUGC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Department Academic Appeals Boards (DAAB) before the date specified in Academic Calendar, by paying the prescribed fees.

b. The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student.

17. AWARD OF DEGREE

17.1 B.Tech. Degree

a) Students shall be declared to have completed the Program of B.Tech. degree and is eligible for the award of degree provided the students have undergone the stipulated Course work of all the semesters under the Scheme of Teaching and Examinations and have earned the prescribed number of credits (160 credits for regular students registered for 4-year degree programs & 120 for lateral entry students).

b) For the award of a degree, a CGPA≥5.00 at the end of the Program shall be mandatory.

c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree to lateral entry diploma students.

d) Earning of Activity Points:

i. Every student entering 4-year degree program should earn 100 activity points & every student entering 4-year degree program through Lateral Entry should earn 75 activity points as per the AICTE Activity Point Program for the award of an Engineering degree.

ii. The activities can be spread over the years (duration of the program) at any time during the semester weekends and holidays, as per the interest & convenience of the students from the year of entry to the program.

iii. The Activity Points earned shall be reflected on the student's eighth-semester Grade Card.

iv. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression.

v. In case students fail to earn the prescribed activity Points before the commencement of 8th-semester examinations, the eighth-semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of a degree only after the release of the Eighth semester Grade Card.

17.2 Honours/ Minors Degree

17.2.1 B.Tech. (Honours) Degree

i. Students must earn a minimum of 18 additional credits in his/her major program discipline entitles a student to get an 'Honours' credential.

ii. Students have to pay additional fees for all the courses registered for 'Honours'

iii. Students with a minimum of 7.5 CGPA and no backlog at the end of the 4th semester will qualify for registering for courses under the 'Honours credential.

iv. Students shall register for 'Honours' courses from the 5th semester onwards.

v. Students should register for additional courses and plan to take courses that are prescribed under that 'Honours' list as per 'pre-requisite' courses to earn the 'Honours' credential.

vi. Students who wish to acquire an 'Honours' credential need to carry out 'Honours' course registration along with their regular semester course registration.

vii. He/she accumulates credits by registering for the required courses, and if the requirements for 'Honours' are met within the prescribed minimum time limit of the program, the 'Honours' will be awarded along with the degree.

viii. Also, the student should meet the following **requirements to become eligible for the 'Honours award.**
- Minimum CGPA of 7.5 in this major discipline at the end of the 8th semester
- Minimum CGPA of 7.0 in the registered 'Honours' courses

ix. In case a student withdraws from the 'Honours' registration in the middle of the program, the 'Honours' courses completed will be converted to 'Audit' courses and indicated accordingly in subsequent Grade Sheets and Consolidated Grade Sheets.

x. It must be noted that the 'Honours' award will be mentioned in the Degree Certificate as **"Bachelor of Technology in (specialization) with Honours".**

xi. This fact will also be reflected in the Consolidated Grade Sheet under a separate heading 'Honours' with similar details shown for other credited courses and the CGPA for 'Honours' will be indicated at the end of the list of courses under 'Honours'.

xii. The grades obtained in the courses credited towards the 'Honours' award are not counted and shall not influence the GPA/ CGPA of the 'program' student has registered.

17.2.2 Minor Degree

i. Students have to earn a min of 18 additional credits from the courses focused on discipline other than his/her major program discipline entitles a student to get a 'Minor' credential.

ii. Students have to pay additional fees for all the courses registered for 'Minor'.

iii. Students with a minimum of 5.0 CGPA and no backlog at the end of the 3rd semester will only qualify for registering for the course under the 'Minor' credential.

iv. Students shall register for 'Minor' degree courses from the 4th semester onwards.

v. All Departments will offer 'Minors' in their varied disciplines and will prescribe what set of courses and/or projects is necessary for earning a minor in that discipline.

vi. Students should register for additional courses and plan to take courses that are prescribed under that 'Minors' list as per 'pre-requisite' courses to earn the 'Minor' credential.

vii. If any of the courses listed under the 'minor' option is a course listed under his/her curriculum as PCC then the student cannot opt for that 'Minor', since all minor courses need to be earned as additional courses to his/her program curriculum and depts decision is final and binding.

viii. Students who wish to acquire a 'Minor' can register for 'Minor' courses along with their regular semester course registration.

ix. Also, the student should have a minimum **CGPA of 5.0 in the 'Minor' courses registered to become eligible for the Minor credentia**l. This fact will also be reflected in the Consolidated Grade Sheet under a separate heading 'Minor in (specialization)'.

x. If the course requirements for a particular 'Minor' are met within the prescribed minimum time limit of the program, the minor will be awarded along with the degree, and it will be mentioned in the **Degree Certificate as "Bachelor of Technology in (Major discipline) with Minor in (specialization)."**

xi. In case a student withdraws from the 'Minor', the 'Minor' courses completed, will be converted to 'Audit' courses and indicated accordingly in subsequent Grade Sheets and Consolidated Grade Sheets.

xii. The grades obtained in the courses credited towards the 'Minor' award are not counted and shall not influence the GPA/ CGPA of the program the student has registered for.

17.2.3 Additional norms for Honours/Minors

i. Students shall register for additional courses to earn Honours/Minors in consultation with their Class Advisor from the list of courses suggested by the DUGC.

ii. DUGC may recommend Massive Open Online Courses (MOOCs)/SWAYAM/NPTEL courses to students who wish to register for Honours/Minors after justifying and establishing the equivalence of the curriculum. The decision of DUGC should be communicated to the Dean of Academics and Controller of Examinations for seeking approval.

iii. A maximum of 40% credits prescribed for Honors/Minors may be earned through MOOCs/SWAYAM/NPTEL

iv. Students may choose to take up additional course work, from the MOOCs courses list suggested by various departments (which can be from SWAYAM/NPTEL) with proctored examinations as approved by the University and complete the same before the last working day of the VIII semester with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates: Completed the course (40-59)– ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD (≥ 90 %)

v. In case, in MOOCs (ex: Coursera), there is no proctored examination, the University will conduct a SEE as deemed to be fit for the award of Credits

vi. The Credit equivalence for online courses shall be as follows –

- 4 weeks of online course duration – 1 credit (approx. 13-14 hours)
- 8 weeks of online course duration – 2 credits (approx. 26-28 hours) and
- 12 weeks of online course duration – 3 credits (approx. 39-42 Hours)

17.3 Noncompliance

17.3.1 Noncompliance of CGPA ≥ 5.00 at the end of the Program

a) Students, who have completed all the courses of the Program but do not have a CGPA ≥ 5.00 at the end of the Program, shall not be eligible for the award of the degree.

b) In the cases of 17.3 (1), a student shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Major), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of a maximum duration of the Program to make up the CGPA equal to or greater than 5.00

for the award of the Degree.

c) Students shall obtain written permission from the Controller of Examinations to reappear in SEE to make up the CGPA equal to or greater than 5.00.

d) In case, the students earn improved grade/s in all the reappeared course/s, the CGPA shall be calculated considering the improved grade/s. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 17.3.1 (b).

e) In case, the students earn improved grade/s in some course/s and the same or lesser than the previously earned pass grade/s in the other reappeared course/s, the CGPA shall be calculated considering the improved grade/s and the pass grades earned before the reappearance. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA<5.00, the students shall follow the procedure laid in 17.3.1 (b).

f) In case, the students earn improved grade/s in some courses and fail in the other reappeared course/s, the CGPA shall be calculated by considering the improved grade/s and the previously earned pass grade/s of the reappeared course/s in which the students have failed. If it is≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 17.3.1 (b).

g) In case, the students fail (i.e., earns an F grade) in all the reappeared course/s, pass grade/s of the course/s earned by the students before reappearance shall be retained. In such cases, the students shall follow the procedure laid in 17.3.1 (b).

i) **Noncompliance with Project/ Mini project**

The project/mini project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the mini-project shall be declared to fail in that course and shall have to complete the same during subsequent University examinations after satisfying the Mini-project requirements.

ii) **Noncompliance of Internship**

All the students of B. Tech shall have to undergo mandatory Internship-I and Internship-II for a total of 10 weeks to earn a total of 10 credits in parts during the vacations at the end of the 1/2/3 academic year. The evaluation of Internship shall be during IV and VIII semesters. The internship shall be considered mandatory for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail in that Course and shall have to complete the same during subsequent University examinations after satisfying the internship requirements.

The maximum duration for a student for complying with the Degree requirements is 16 – semesters from the date of first registration for his/ her first semester (8 years from the date of admission to the first year, (12 semesters / 6 years from the date of admission for lateral entry student)).

18. GRADUATION REQUIREMENTS AND CONVOCATION

18.1 A student shall be declared to be eligible for the award of the degree if he/she has

a) Fulfilled "Award of Degree" Requirements

b) No Dues to the College, Departments, Hostels, Library, Central Computer Centre and any other centers

c) No disciplinary action is pending against him/her.

18.2 The award of the degree must be recommended by the Governing council.

18.3 **Convocation:** Degree will be awarded to the students who have graduated during the preceding academic year. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the degree requirements (refer to "Award of Degree") within the specified date to arrange for the award of the degree during convocation.

19. AWARD OF PRIZES, MEDALS, CLASS & RANKS

19.1 For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the University for such awards. Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of university examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class, and Second Class as described in Section 15.

19.2 An attempt means the appearance/registration of a candidate for an examination in one or more courses either in part or failing a particular examination.

i) A candidate who fails/remains absent (after submitting exam application) in the main examination and passes one or more subjects/courses or all subjects/courses in the supplementary/Make-up examination such candidates shall be considered as taken more than an attempt.

19.3 Merit Certificates and University Medals/ will be awarded based on overall CGPA, governed by the specific selection criteria that may be formulated by the University for such Medals / Awards

i) Only those candidates who have completed the Program and fulfilled all the requirements in the minimum number of years prescribed (i.e., 3 years for Diploma lateral entry students or 4 years for students who joined after the 12th standard) and who have passed each semester in the **first attempt** are eligible for the award of Merit Certificates and /or University Medals.

ii) Candidates with W, N, I, X & F grades and who passes the courses in the subsequent/supplementary/make up examinations are not eligible for the award of Gold Medal or Merit Certificate.

20. CONDUCT AND DISCIPLINE

20.1 Students shall conduct themselves within and outside the premises of the College in a manner befitting the students of an Institution of National Importance.

20.2 **As per the order of the Honorable Supreme Court of India, ragging in any form is**

considered a criminal offense and is banned. Any form of ragging will be severely dealt with.

20.3 The following acts of omission/ or commission shall constitute a gross violation of the Code of Conduct and are liable to invoke disciplinary measures:

i. Ragging.
ii. Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.
iii. Willful damage or stealthy removal of any property/belongings of the College/Hostel or fellow students/citizens.
iv. Possession, consumption, or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
v. Mutilation or unauthorized possession of Library books.
vi. Noisy and unseemly behavior, disturbing studies of fellow students.
vii. Hacking in computer systems (such as entering into another Person's area without prior permission, manipulation and/or Damage of computer hardware and software, or any other Cybercrime, etc.).
viii. Plagiarism of any nature.
ix. Any other act of gross indiscipline as decided by the Senate from time to time.
x. Use of Mobile in the college Academic area.
xi. Smoking in College Campus and supari chewing.
xii. Unauthorized fundraising and promoting sales.
xiii. Commensurate with the gravity of the offense the punishment may be: reprimand, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

20.4 For an offense committed in (i) a hostel (ii) a department or a classroom and (iii) elsewhere, the Chief Warden, the Head of the Department, and the Dean (Academics), respectively, shall have the authority to reprimand or impose fine.

20.5 All cases involving punishment other than reprimand shall be reported to the principal.

20.6 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

20.7 **Note:** Students are required to be inside the examination hall 20 minutes before the commencement of the examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

****

APPENDIX - A

Definitions, terminology, and abbreviations

1. **Nitte DU / University**
   a. Refers to Nitte (Deemed to be University)

2. **BoM**
   a. Refers to Board of Management of Nitte (Deemed to be University)

3. **BoS**
   a. Refers to the Board of Studies in Mechanical Engineering

4. **Institute/Institution**
   a. Refers to NMAM Institute of Technology, Nitte

5. **Program**
   a. A range of learning experiences over a specified period, leading to the award of a degree/diploma/certificate. A program is completed when the courses that make up the program are completed, and other requirements as specified in the program regulations are met.

6. **Course**
   a. A unit of learning that typically lasts one semester, led by one or more teachers, for a fixed roster of students. Often referred to as a "subject". A course has identified course outcomes, modules/units of study, specified teaching-learning methods, and assessment schemes. A course may be designed to include lectures, tutorials, practical, laboratory work fieldwork, project work, internship experiences, seminars, self-study components, online learning modules, etc. in any combination.

7. **Semester**
   a. An academic session, usually of 16 weeks duration, with a minimum of 90 working days during which coursework and assessments are to be completed. Typically, two semesters make up an academic year, with the first of these referred to as the Odd Semester and the second as the Even Semester.

   b. An additional short semester (usually 8 weeks) may be offered between an even semester and subsequent odd semester (in the interval between two academic years) and is termed a summer semester. The summer semester is offered to enable students to register for:
      i. Fast-tracked courses required for clearing backlog courses.
      ii. Fast-tracked courses for earning additional credit / completing non-credit mandatory requirement.
      iii. Value added courses.
      iv. The courses offered in summer semesters are bound by the same regulations as that of regular semesters, except that they are run at an accelerated pace to provide the required contact hours and conduct assessments within the 8 weeks.

8. Credit

a. A unit by which the course work is measured. It determines the number of hours of formal learning (contact hours) required per week. Credits are calculated based on the concept of "notional learning time". Notional learning time is the number of hours that a learner is expected to spend, on average, to achieve the specified learning outcomes of the course. This may comprise a variable combination of scheduled learning activities, (lectures, seminars, labs, etc.) and self-directed learning time (reading required before classes, working on assignments, examination preparation, and completion of assessments).

9. Credit equivalence of notional learning time for different types of activities

a. The credit values assigned to various teaching-learning activities are as follows:

Type of teaching-learning	Nature of activity	No. of contact hours per week equivalent to one credit	The total number of contact hours over a 16-week semester is equivalent to one credit
Lectures / Seminars / synchronous virtual classes / synchronous webinars	Scheduled instruction	1:1	16
Tutorials	Scheduled instruction	2:1	32
Supervised Demonstrations /Laboratory sessions / Studio / Workshops / Workplace simulation / Skill Practice Sessions	Scheduled instruction	2:1	32
Supervised Field visits/community visits/Internships	Scheduled instruction	3:1	48
Scheduled self-directed study (individual or group)	Scheduled instruction	2:1	32
Asynchronous E-Learning modules (structured self-directed study	Independent learning	2:1	32
Student Seminar	Independent /small group learning	2:1	32
Project work/dissertation	Independent /small group learning	3:1	48
Internship for credit	Industry placement/ Research Internship	3:1	48

10. Choice-based credit system (CBCS)

A program structure for higher education requires students to earn a minimum of credits by completing various types of courses, including electives, which facilitate a student to have some freedom in selecting his/her own choices, within as well as across disciplines.

11. Course Registration

Refers to formal registration of the Courses in the study every semester (Credits and Audit) by every student under the supervision of a faculty advisor. The institution will maintain records of the same and communicate them to the University.

12. Learning outcomes

a. Program Outcomes (PO) - Statements defining the skills, knowledge, and attitude that graduates of a program will be able to demonstrate upon completing the program.

b. Course Outcomes (CO) - Statements defining the skills, knowledge, and attitude that students will be able to demonstrate upon completing the course. COs are mapped to the POs such that attaining the course outcomes leads to the attainment of program outcomes.

c. Attainment of POs-COs is mapped to the POs such that attaining the course outcomes leads to the attainment of program outcomes.

13. Evaluation

For all courses, the evaluation will be based on both formative assessment (Continuous Internal Evaluation, CIE) and summative assessment (Semester End Evaluation, SEE). Weightage for CIE and SEE will be 50% each.

13.1 Continuous Internal Evaluation (CIE)

Refers to the periodic and continuous *formative assessment* of students' performance during the semester by the teacher(s) of the course to provide timely feedback to students and for guiding "course corrections" by the teachers. The assessment methods may include tests, quizzes, assignments, project evaluations, portfolio evaluations, seminar assessments, etc. CIE will have a weightage of 50% in the determination of the final grading of the course.

13.2 Semester End Evaluation (SEE)

Refers to a *summative assessment* that covers the entire course syllabus, conducted by the University, at the end of the semester. Appropriate assessment methods aligned with the learning domain and teaching-learning methods are to be used. CIE will have a weightage of 50% in the determination of the final grading of the course.

14. Grading

Course Grade refers to a qualitative measure of performance of a student in each course, based on the percentage of marks secured in Continuous Internal Evaluation (CIE) and Semester End Evaluation (SEE). A Letter grade is awarded for each course.

15. Semester Grade Point Average (SGPA)

Refers to the measure of a student's academic performance in a semester. It is calculated based on the credits and the grades obtained in the courses offered in the semester.

16. Cumulative Grade Point Average (CGPA)

Refers to the measure of the cumulative performance of a student in all the previous semesters and is computed from the 2nd semester onwards. It is calculated based on the credits and the grades obtained in all the courses taken.

17. Academic Bank of Credits (ABC)

The Academic Bank of Credits is a national-level facility for “credit transfer”. It is provided by the Ministry of Education, Govt. of India, to promote the flexibility of the curriculum framework and interdisciplinary/multidisciplinary academic mobility of students across the Higher Education Institutions in the country. The banking and redemption of credits through ABC will be governed by the University’s guidelines.

APPENDIX-B

Evaluation Guidelines

CIE and SEE details for various types of courses

1. **Theory: PCC/IPCC/PEC/OEC**
   1.1. **Scheme of examinations: CIE+SEE =50+50=100 marks**
   1.2. **Continuous internal evaluation (CIE):**
   1.2.1. **CIE (PCC/PEC/OEC)**

Type of Questions	Questions to be set (Can have sub-questions a and b)	Questions to Be answered	Marks per question	Total marks
Mid Sem Exam-1				
40% of the total syllabus (Unit-1) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-2	2	1	10	10
Mid Sem Exam-2				
40% of the total syllabus (Unit-2) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-1	2	1	10	10
TASKS				
TASK	The task comprises 5 class tests/quizzes/assignments conducted for each unit for a max mark of 10. All tests/quizzes/Assignments are compulsory			10
Maximum Marks				**50**

1.2.2 **CIE (IPCC/PBL)**

Type of Questions	Questions to be set (Can have sub-questions a and b)	Questions to be answered	Marks per question	Total marks
Mid Sem Exam-1				
40% of the total syllabus (Unit-1) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-2	2	1	10	10
Mid Sem Exam-2				
40% of the total syllabus (Unit-2) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-1	2	1	10	10
Task	The task comprises 5 class tests/quizzes/assignments conducted for each unit for a max mark of 10. All tests/quizzes/Assignments are compulsory.			10
Maximum Marks				**50**
60% weightage, converted to 30 marks				
Practical/Project Based Learning (PBL)				
Practical/PBL	Practical/PBL (comprises of implementation of theoretical concepts through projects/problem solving)			**50**
40% weightage, converted to 20 marks				
Maximum Marks [30 (Theory)+ 20 (Practical/PBL)]				**50**

1.2.3 Semester End Evaluation (SEE): 3 Hours Duration

Type of Questions	Module & Teaching hours	Questions to be set (Can have sub-questions a, b, and c)	Questions to be answered	Marks per question	Total marks
MCQ	Entire Syllabus	10 or 20	All Questions	2 or 1	20
Descriptive	• Unit-1 • 15 teaching hours	3	2	16	32
Descriptive	• Unit-2 • 15 teaching hours	3	2	16	32
Descriptive	• Unit-3 • 10 teaching hours	2	1	16	16
				Maximum Marks	**100**
SEE Marks with 50% Weightage					**50**

1.2.4 CIE & SEE for various types of courses

Sl. No.	Courses		Evaluation scheme			
			CIE (Minimum eligibility marks 40% of Max marks		SEE (Minimum Passing marks 40 % of Max marks)	
			Max Marks	Min eligibility marks required	Max Marks	Minimum passing marks required
1	Integrated Professional Core Course (IPCC)	Theory	30	12	50	20
		Practical	20	08	---	---
		Total	50	20	50	20
2	PCC with PBL component	Theory	30	12	50	20
		PBL component	20	08	--	--
		Total	50	20	50	20
3	PCC/PEC/OEC		50	20	50	20
4	Laboratory		50	20	50	20
5	Drafting		50	20	50	20
6	Mini Project		100	40	---	---
7	Inter/Intra Institutional Internship (2 weeks)		100	40	---	---
8	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship (In single or two stretches =Total of 8 weeks)		100	40	100	40
9	Research Internship/ Advanced Industry Internship/Project work		100	40	100	40
10	Seminar		100	40	---	---

All university examinations (SEE) shall be conducted for a maximum of 100 marks. For assigning the letter grade the university examination marks secured by a student, except in the case of serial no. 06, 07, and 10 shall be reduced to 50 marks and added to CIE marks. If the total marks result in a fraction during reduction, it shall be rounded off to the nearest higher value.

2 Laboratory/Practical Course

2.1 Split-up of Marks for evaluation of Practical for 50 CIE marks and 50 SEE marks.

2.2 Split-up of Marks for evaluation of Laboratory work:

2.2.1 Laboratory in-charge faculty will follow rubrics given in the Tables below for an evaluation of laboratory courses

2.2.2 In the case of Practical, the IA marks shall be based on laboratory observation, records, viva, and at least one practical test.

2.2.3 Continuous Evaluation in every lab session will be done using the format mentioned in the Table to evaluate PO9 (Individual and teamwork) and PO10 (Communication).

2.2.4 Rubrics used for continuous Evaluation of **laboratory courses involving experiments with hardware**

Lab conduction and Record			**Lab Internal Assessment**		
Split-up: **60% (30 Marks) of Maximum CIE marks (50).** Each experiment is to be evaluated for conduction with an observation book and record write-up (**30 marks per experiment).** The final marks for conduction and record are the average of all the specified experiments in the syllabus.			Split-up: **40% (20 Marks) of Maximum CIE marks (50). One test of 20 Marks** In the test, conduction of the experiment and acceptable result with viva-voce will carry a weightage of 60% per experiment, with the rest 40% for procedural knowledge and regularity of the student.		
Rubrics per experiment	**Marks Distribution**	**Remarks**	**Rubrics**	**Marks distribution**	**Remarks**
Circuit	02	Evaluation of Record write-up to include weightage for submission on time, neatness, etc.	Write-up	04	
Design	02		Conduction	10	
Procedure	02		Results	06	
Conduction	06				
Viva	06				
Record write-up	12				
Total Marks	30		**Total Marks**	20	

2.2.5 Split-up of Marks used for continuous Evaluation of laboratory involving experiments with software

Rubrics for Split up of Marks	Methodology / Process Steps per Experiment	Marks
#R1	Observation, Write up of Procedure / Algorithm/ Program execution, and Conduction of experiment	12
#R2	Viva – Voce	06
#R3	Record writing	12
	Total Marks for each experiment	30
#R4	Internal Test: Lab Internal Assessment (i) Write-up of Procedure/Program/Algorithm (ii) Conduction/Execution (iii) Viva-Voce	 04 10 06
	Total Marks	20

3. Internship and Evaluation

3.1 Introduction

The rise in global competition has prompted organizations to devise strategies to have a talented and innovative workforce to gain a competitive edge. Developing an internship policy is an impactful strategy for creating a future talent pool for the industry. The internship (a form of experiential learning) program not only helps fresh pass–outs in gaining professional know-how but also benefits corporate sectors. The internship also enhances the employability skills of the student passing out from Technical Institutions.

The following list provides a brief illustrative overview of the knowledge, skills, work habits, and character traits commonly associated with 21st-century skills and to be acquired by graduates:

- Critical thinking, problem solving, reasoning, analysis, interpretation, and synthesizing information.
- Scientific literacy and reasoning, the scientific method.
- Research skills and practices, interrogative questioning.
- Creativity, artistry, curiosity, imagination, innovation, and personal expression.
- Information and communication technology (ICT) literacy, media and internet literacy, data interpretation and analysis, and computer programing.
- Oral and written communication, public speaking and presenting, listening.
- Economic and financial literacy, entrepreneurial skills.
- Global awareness, multicultural literacy, humanitarianism.
- Environmental and conservation literacy, ecosystems understanding.
- Civic, ethical, and social-justice literacy.
- Leadership, teamwork, collaboration, cooperation, and facility in using virtual workspaces.

- Perseverance, self-direction, planning, self-discipline, adaptability, initiative.
- Health and wellness literacy, including nutrition, diet, exercise, and public health and safety.

The internship experience will augment the outcome- based learning process and inculcate various attributes mentioned above in a student in line with the graduate attributes defined by the NBA as well as NEP 2020

Following are the intended objectives of internship training.

(i) Expose Technical students to the industrial environment, which cannot be simulated in the classroom, and hence create competent professionals in the industry.

(ii) Provide possible opportunities to learn, understand and sharpen the real- time technical/managerial skills required at the job.

(iii) Expose to the current technological developments relevant to the subject area of training.

(iv) Use the experience gained from the industrial internship in discussions held in the classrooms.

(v) Create conditions conducive to the quest for knowledge and its applicability on the job.

(vi) Learn to apply technical knowledge in real industrial situations.

(vii) Gain experience in writing reports on technical works/projects.

(viii) Expose students to the engineer's responsibilities and ethics.

(ix) Familiarize with various materials, processes, products, and their applications along with relevant aspects of quality control and safety measures.

(x) Promote academic, career, and/or personal development.

(xi) Expose the students to future employers.

(xii) Make students available to the industry for employment.

(xiii) Understand the psychology of the workers and their habits, attitudes, and approach to problem-solving.

(xiv) Understand the social, economic, and administrative considerations that influence the working environment of industrial organizations.

3.2 Academic credit framework for the internship and project work undergone as part of the B.Tech. program.

- A minimum of 20 credits of Internship/ Entrepreneurial activities / Project work/ Seminar and Inter/ Intra Institutional Training may be counted towards B. Tech. degree program
- Here, 1 credit is equivalent to a minimum of 40-45 hours of work. Therefore, a full-time intern is expected to spend 40 - 45 hours per week on Internship, Training, Project work, Seminar activities, etc. This will result in about 800 to 900 hours of total internship and project duration for the B. Tech program.
- To derive the benefits of an internship, it is introduced in two/ three stages of the B.Tech. program.
- Internships may be full-time or part-time; they are full-time during the summer vacation and part-time during the academic session. The curriculum is flexible to adjust internship duration. Therefore, opportunities must be provided for experiences that cannot be anticipated when planning the course.

- The departments have the flexibility to schedule internships, Project work, Seminars, etc. according to the availability of the opportunities. However, the suggested minimum requirement regarding Internship duration and credits are as given in Table -B1.

Table-B1 Suggested Credit Framework for Internship and Project work.

Sl. No.	Title	Schedule	Duration	Activities	Credits
1	Internship-I	Ongoing First-year academic session/ Summer vacation after 2nd Semester/ vacation during 3rd semester (for lateral entry students	02 weeks	Inter/ Intra Institutional Activities (Evaluation in 4th semester)	02
2	Internship-II	a) Summer vacation after 4th Semester	02-04 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship/ social internship	---
		b) Summer vacation after 6th Semester	04-06 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship	
		c) Total of a) and b) at the beginning of the 8th semester	08 weeks	Evaluation in 8th Semester	08
3	Project work	6th Semester	6 hours/week	Mini -Project	02
		8th Semester	16 weeks	Extended Industry Internship /Research Internship/ Project work	10
				Report preparation and writing	
				Seminar	01
Total Credits					**23**

Table-1 states that during the ongoing/ summer vacations after the 2nd Semester, students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions, etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos, etc.

During the summer vacation after the 4th/ 6th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

3.3 Internship Supervision

i) The internship shall be carried out under the supervision of a faculty mentor. The faculty mentor/guide should,
ii) Serve as a teacher, mentor, trainer, critic, leader, and boss.
iii) Provide sufficient time to guide the interns. (Interns are students or a trainee who does a job to gain work experience)
iv) Play a vital role, along with the Training and Placement Officer, in providing internship opportunities for the students.
v) Exhibit qualities such as leadership, strong communication skills, and patience.
vi) Provide a letter of recommendation in due consultation with students and the industrial organization (if possible) where the internship is intended to be carried out, endorsed by the authority (Principal/Institution Internship Coordinator).

3.3.1 Each faculty mentor shall supervise the students/Student batches allotted to them. Often, the supervision may be by an external expert. In such cases, the faculty mentor shall jointly guide the student/s without causing miscommunications/embarrassment to either side.

3.3.2 Depending on the activity taken up by the students, the internship shall be carried out individually or in batches having not more than three students.

3.3.3 Faculty Mentor, along with the external expert, shall scrupulously evaluate the work of an individual student or students of a batch and maintain the relevant documents.

3.3.4 For allotment of CIE marks, the institutions shall prepare the rubrics for each activity offered by the institution as given in Table - B2. The marks shall be allotted by the Internship committee designated by HOD in consultation with the mentors.

3.3.5 For all activities conducted by the institution, the attendance of the students shall be maintained by the faculty and maintained in their respective departments.

3.4 Internship-I (Activity based Internship)

While intra-activities are within the institution, inter-activities shall be between the concerned institution and neighboring institutions. Intra and Inter activities are the activities that are the impetus to learning techniques. It adds to the comprehensive growth of the mind and associated activities.

As the students are on the verge of learning technical aspects and have a limited period of internship, it is preferable to expose students to polygonal activities instead of one type of activity. Therefore, activities completed by the students shall not be one type of activity but can be few within the period of the internship. In this regard, Intra and Inter-Institutional activities shall be completed under the supervision of a faculty on a self-learning basis.

The faculty have to kindle the latent abilities of the students, encourage, guide, supervise and shape them to achieve the desired result. Therefore, a learning agenda in the form of specific learning objectives and outcomes shall be prepared before the start of the internship.

Whatever the activity/activities that are/are done under Intra and Inter-Institutional activities, should ignite the inquisitiveness to learn, enhance the knowledge, thinking ability and imagination, planning, application of mind, execution ability, innovation attitude, listening and understanding, vocabulary, personal expression, public speaking, written communication, oral presentation of the subject matter, acquire leadership qualities and teamwork requirements, responsiveness, ethics, etc.

3.4.1 List of proposed activities

a. Activities concerned with the works of Indian scholars like Charaka and Susruta, Aryabhata, Bhaskaracharya, Chanakya, Madhava, Patanjali, Panini, and Thiruvalluvar, among numerous others
b. Activities such as training with higher Institutions or Soft skill training
c. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
d. Learning at Departmental Lab/Tinkering Lab/ Institutional workshop.
e. Working for consultancy/ research projects within the institute.
f. Learning MS Word, Excel, Microsoft equations, MS drawing tools, MS Powerpoint, etc.
g. Coding.
h. Mini projects using commercially available assembled electronic products.
i. Debates, quizzes, and group discussions: On technical topics already studied (both in Kannada and English).
j. Essay competitions: Both in Kannada and English on technical topics already studied.
k. Survey and study of published literature on the assigned topic: Technical paper survey, Preparation of synopsis. Exposure to technical paper publications.
l. Photography.
m. Short film production: Contemporary aspects, technical aspects, etc.
n. Internship in Disaster Management.
o. Solar energy connected activities that help the common man.
p. Working with Smart City Administration.
q. Hackathon (it is a design sprint-like event in which computer programs and others involved in software development, including graphic designers, interface designers, project managers, and others, often including domain experts collaborate intensively on software projects).
r. Industrial Safety, Fire Safety, Electrical Safety, Chemical Process Safety, Food Safety, etc.
s. Internship and project work in Indian Knowledge System related Areas/Topics.
t. Industrial visits to Small Scale Industries/ Factories/ Cottage Industries/substation visits etc., and submission of the report.

3.5 Documents to be submitted by Students for Internship Evaluation

3.5.1 Student's Diary

The main purpose of writing a daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the student's thought process and reasoning abilities. The students shall record in the daily training diary the day-to-day account of the observations, impressions, information gathered, suggestions given, if any, and activities carried out. It should contain sketches and drawings related to the observations made by the students. The daily training diary should be signed after every day or at least twice a week by the faculty/ in charge of the section (external expert) where the student has been working.

Student's Diary should be submitted by the students along with attendance records. It shall be evaluated based on the following criteria:

i) Regularity in the maintenance of the diary.
ii) Adequacy and quality of information recorded.
iii) Drawings, sketches, and data were recorded.
iv) Thought processes and recording techniques were used.
v) Organization of the information

3.5.2 Internship report

After completion of the Internship, the student shall prepare, with a daily diary as a reference, a comprehensive report in consultation with the mentor/s to indicate what he/she has observed and learned in the training period along with the internship outcomes. The training report should be signed by the mentor. The Internship report shall be evaluated based on the following criteria and/or other relevant criteria about the activity completed.

- **i)** Originality.
- **ii)** Adequacy and purposeful write-up.
- **iii)** Organization, format, drawings, sketches, style, language, etc.
- **iv)** Practical applications, relationships with basic theory, and concepts taught in the appropriate course.
- **v)** Variety and relevance of learning experience.

Procedure for the Evaluation of Internship-I

- **a)** Students should submit the reports immediately on completion of the Internship to the respective mentors
- **b)** The Examination of the internship will be carried out by the mentor
- **c)** The Internship-I shall be slated for 100 marks CIE only and will not have SEE.
- **d)** Internship-I marks are based on CIE marks (25 marks for the first presentation, 25 marks for the second presentation, and 50 marks for the report and final presentation).
- **e)** A Viva-Voce examination conducted during the I/II/III Semesters (Presentation followed by question-answer session) and the prescribed credit shall be included in the IV semester grade card.

3.5.3 Assessment Rubrics for evaluation of Internship-I (Intra and Inter-Institutional Activities)

Table – B2 Internship-I Assessment Rubrics
Scheduled during the first year (Prescribed Period 02 weeks and Prescribed credits: 02)

Sl No	Sub Activity Head	Performance/ Appraisal	Assessment Rubrics (Allotted marks decide the letter	Proposed Document as Evidence	Evaluated by
1	Inter/ Intra Institutional Workshop/ Training.	Excellent	80 to 100	**(i)** Student's Diary and **(ii)** Internship Report along with the certificate issued from the relevant authorized Authority	Institute Faculty (mentor) together with External Expert, if any.
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
2	Working for consultancy/ Research project.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
3	Festival (Technical / Business / Others) Events.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
4	Contribution in	Excellent	80 to 100		
		Good	60 to 79		

	Incubation/ Innovation/ Entrepreneurship Cell	Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
5	Learning at Departmental Lab/Tinkering Lab/Institutional workshop.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
6	Other than the above five activities	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
Note: The total CIE marks shall be the sum of marks allotted to completed activities by the student.					

3.6 Internship-II: (Societal internship and Research/Industry Internship) (08 weeks) [Scheduled during the intervening period of IV & V semester and VI & VII semester]

During the intervening period of the IV & V semesters and VI & VII semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo an Internship involving Innovation / Entrepreneurship/short-term (about 2 weeks) societal-related activities. Students may choose to work on innovation or entrepreneurial activities, or both resulting in start-up or undergo internship with industry/NGO/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

3.6.1 Innovation

Innovation refers to a new or improved product or process or a combination thereof that differs marginally or significantly from the unit's previous product. An innovation center is a place where students are encouraged to implement the innovative ideas formed through imagination, brainstorming sessions, design thinking, and associated activities to bring them to reality. It is a place, where creative minds are shaped.

3.6.2 Entrepreneurship

Entrepreneurship refers to setting up a new business or business and taking on financial risks in the hope of profit. It involves investment to undertake production along with arranging inputs like land, labour, material, and capital, introducing new techniques and products, identifying new sources for the enterprise, etc.

3.6.3 Incubation Center

An organized unit designed for innovation as well as to accelerate the growth and success of new entrepreneurial companies through mentorship and an array of business support resources and services that could include physical space, capital, coaching, common services, and networking connections.

3.6.4 Startup

An entity that develops a business model based on either product innovation or service innovation and makes it scalable, replicable, and self-reliant.

An entity shall be considered a Startup

i) Up to ten years from the date of incorporation/ registration, if it is incorporated as a private limited company (as defined in the Companies Act, 2013) or registered as a partnership firm (registered under section 59 of the Partnership Act, 1932) or a limited liability partnership (under the Limited Liability Partnership Act, 2008) in India.

ii) Turnover of the entity for any of the financial years since incorporation/ registration has not exceeded one hundred crore rupees.

iii) The entity is working towards innovation, development, or improvement of products or processes, or services, or if it is a scalable business model with a high potential for employment generation or wealth creation.

iv) Provided that an entity formed by splitting up or reconstruction of an existing business shall not be considered a Startup.

3.6.5 Societal (Social) related activities

Short-term internships (about 2 weeks) in villages, slums, or urban areas can be under social internship. The internship will be more fruitful if students work in teams. The teams can select one or more fields to do their best in the field of agriculture, watershed management, wastelands development, non-conventional energy, low-cost housing, sanitation, nutrition and personal hygiene, schemes for skill development, income generation, blood bank, and government schemes such as

i) (Swachch Bharat: Swachh Bharat Mission, Swachh Bharat Abhiyan, or Clean India Mission is a country-wide campaign to eliminate open defecation and improve solid waste management.

ii) Accessible India: Accessible India Campaign or Sugamya Bharat Abhiyan is a program to serve the differently able community of the country.

iii) Digital India: A campaign to ensure the Government's services are made available to citizens electronically by improved online infrastructure and by increasing Internet connectivity or making the country digitally empowered in the field of technology.

iv) Beti Bachao and Beti Padhao: A campaign of the Government of India that aims to generate awareness and improve the efficiency of welfare services intended for girls in India.

v) Environment and Energy Conservation and Education, legal aid, consumer protection, and allied field including Indian Red Cross Society, National Cadet Corps, Bharat Scouts, and Guides.

Societal activities are one of the NBA graduate attributes that are part of PO6 and PO7, which are reproduced below.

vi) PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

vii) PO-7: Environment and Sustainability: Understand the impact of the professional engineering solution in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development. The long-term goal under Societal (social work) related activities, particularly in a rural area, results in a rural internship. In urban areas, the student may adopt slum/ economically weaker section areas for short duration social internship to uplift the living conditions.

Given the above, internship coordinators should encourage students to take up a societal internship as far as possible.

3.6.6 Places for Innovation/Entrepreneurial Activities

Students shall carry out Innovation or Entrepreneurial activities or both at the Incubation Center and Entrepreneurship Cell of the parent institution or elsewhere such as ATAL

Incubation Centers [A flagship of Atal Innovation Mission (AIM), NITI Aayog for promoting the culture of innovation and entrepreneurship in India], institutes of national importance, public sector units, IT companies, government organizations, and non-governmental organizations, industries including MSME, etc.

- **Institutes should deter students to opt for internships at places established for commercial benefits.**

3.6.7 Industrial Internships

The gap between the theoretical knowledge obtained in the classrooms and the practical skills required in the actual workplace scenarios is fast growing. This has put forth varied challenges to graduating students when it comes to job placements. As institutes cannot have a relevant facility to expose students to a real-time industrial environment, an industrial internship is an appropriate solution.

The main objective of the industry internship is to ensure that the intern is exposed to a real job world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

3.6.7.1 Industry Internship Benefits

i) Have ample opportunities to attend seminars, symposiums, workshops, etc. This in turn provides an opportunity to establish rapports with professionals and pioneers in their respective fields for further growth.
ii) Have wide scope to publish paper/s in journals.
iii) Good recommendation letter/s that increase the prospectus for further internships, higher studies, and placements.
iv) Helps to acquire team spirit, motivated acts, techniques to resolve conflicts, etc.
v) Helps to develop a lot of leadership skills.
vi) Increases the prospect of placement in the same concern, provided the intern has exhibited a clear understanding of basics and completed the internship.
vii) Fosters to substantiate the issues with facts and figures.

For AICTE Internship opportunities refer to https://internship.aicte-india.org/

3.6.8 Assessment Rubrics for Innovation / entrepreneurship/ Societal Internship Activities

Once the internship begins, the students are required to maintain a diary/journal and submit a report regularly to the guide. These reports should summarize the activities in which the student was involved during the previous week's period. At the end of the internship, each student is required to submit a hard copy of the consolidated diary/journal and report for evaluation. The report should indicate the learning and achievements of the internship.

<table>
<tr><th colspan="5">Table – B3 Innovation/entrepreneurship/ Societal Internship Activities and Assessment Rubrics
Scheduled during the intervening period of IV & V semester and VI & VII Sem
(Prescribed Period 08 weeks: Credits 08)</th></tr>
<tr><th>Sub Activity Head</th><th>Performance/ Appraisal</th><th>Assessment Rubrics</th><th>Proposed Document as Evidence</th><th>Evaluated by</th></tr>
<tr><td rowspan="4">(1) Development of new product/ Business Plan/ registration of start-up/societal internship</td><td>Excellent</td><td>80 to 100</td><td rowspan="8">(i) Student’s Diary and (ii) Internship Report or the activity report along with Certificate or Declaration from relevant Authorized Authority. Wherever only Certificate is issued, Assessment shall be at the institute as per (i) and (ii) to decide the letter grade.</td><td rowspan="8">(i)Institute Faculty (mentor) together with External Expert if any.</td></tr>
<tr><td>Good</td><td>60 to 79</td></tr>
<tr><td>Satisfactory</td><td>40 to 59</td></tr>
<tr><td>Unsatisfactory and fail</td><td>< 39</td></tr>
<tr><td rowspan="4">(2) Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/Medium Enterprise.</td><td>Excellent</td><td>80 to 100</td></tr>
<tr><td>Good</td><td>60 to 79</td></tr>
<tr><td>Satisfactory</td><td>40 to 59</td></tr>
<tr><td>Unsatisfactory and fail</td><td>< 39</td></tr>
<tr><td colspan="5">Note:
(i) The total CIE marks shall be the sum of marks allotted to successfully completed activities by the student.</td></tr>
</table>

3.7 Research Internships / Extended Industry Internships

3.7.1 Research Internship /Extended Industry Internship of sufficient duration encourages students early on in their careers. Its main goal is to allow improving their analytical and technical skills in an international environment. An internship can be in an industry or at an appropriate workplace.

3.7.2 Research internships and industrial internships have different purposes and come with a set of benefits. A prior experience in any field is always preferred over a fresh start. Therefore, one of them can be selected depending on the interest the students have. Internships pose unexpected challenges and make students think appropriately, tackle difficulties with ease, and act in a scholarly way to get past the hurdles and practical constraints. An internship is always beneficial however good or bad it is.

3.7.3 Internships not only enhance one’s learning but also identifies him/her as someone who commits to approaching a project and completing it with or without guidance. Internship learning is an impetus for professional development.

3.7.4 While a research internship is a stepping stone to higher studies, an industry internship is a pathway to a placement. Those who are self-motivated and interested in searching for new things that are original and unique can choose a research internship. Those who are interested in real industry- experience and aspire to get a job soon after graduation can choose an industry internship.

3.7.5 Research Internships (Also known as dissertation internships) are focused research projects that push students’ intellectual abilities beyond those driven by the classroom. Often, a research internship typically helps solve problems that are usually part of major research projects. It involves a short theoretical or experimental research project supervised by a researcher.

3.7.6 The research internships, under the advice of a faculty supervisor, can be one’s own selected project or a project on which a Researcher is researching, or a new project/real-world project offered by an organization. The research area may be about single or multidisciplinary fields such as science, technology, engineering, mathematics, management, and business studies. Research internships can be carried out either individually or in teams (not exceeding 3 or 4 students).

3.7.7 Research internship opportunities, before graduation, maybe in a laboratory of college, a research institute, or a company's R & D department. Apart from fixed working hours of the day of an organization, the researcher can devote sufficient time to other research-related activities for early and successful completion of the Research Internship.

3.7.8 Necessary Skills for Research Internship and Industrial Internship

For the internships to progress without hurdles and for successful completion, the Researchers should maintain a harmonious relationship with the guide/s, administrators, co-workers, and others, and strictly adhere to the rules and regulations of the workplace. The other skills required or acquirable during the Internship are,

1. Good Communication skills.
2. Attention to detail.
3. Planning and scheduling.
4. Documentation.
5. Critical thinking.
6. Data collection.
7. Data analysis.
8. Ability to maintain quality, safety, and/or infection control standards.
9. Appreciating and practicing ethical issues.

3.7.9 Responsibilities of an Intern

Interns,

1. If working with a researcher, shall assist the researcher in an ongoing research project or work collaboratively in designing a new project of mutual interest.
2. Shall engage in literature survey and get an insight of the research work at the initial stages.
3. Shall compile data, sort, file, implement ideas with minimal guidance and assist write papers.
4. Shall become familiar with several tools [meters (Electrical and Electronics, mechanical, computer, etc.)] used in data collection, software, graphic software, Statistical Package for the Social Sciences (SPSS) software [IBM's statistical software platform], etc.
5. Shall attain skills with Microsoft Word Office, Excel, PowerPoint, Outlook, etc.
6. Shall give a mid-term oral presentation to a committee for review and feedback.
7. Shall attend discussions, meetings, symposiums, classroom lectures, etc., to learn new scientific techniques, design experiments, analyze results, and formulate different hypotheses.
8. Shall learn to write reports and be able to correspond independently.
9. Shall manage time effectively.
10. Shall keep a track of the progress of the project.
11. Shall develop integrative thinking.

3.7.10 Research internship Outcomes

1. Generating technical paper/s and publishing in refereed journal/s.

2. Possibility of acquiring intellectual ownership and patent.
3. Build a prototype for an idea on which the research was carried out.
4. File patent/s.
5. Add academic knowledge to the field.
6. Enhanced ability in arranging meetings, presentations, seminars, training, etc.
7. Improved conscientiousness and ethics.

3.7.11 Research internships Benefits

1. Are a great way to pursue an academic career in teaching and research, as a Research Scientist at a Research Organization, Company, Industry sector, etc.
2. Establish professional networks for a future career.
3. Pave the way to join a research team and work alongside leading experts in the field.
4. Introduced to new ideas through interaction with like-minded students and others.
5. Develop research skills and knowledge in a specific area of interest.
6. Provide opportunities for growth, achievement, and personal development.

   Offer an opportunity to publish a research paper that will boost the resume while applying for Post Graduate Studies

4. Evaluation Procedure of UC3001-1 Research Internship /Extended Industry Project/Internship/Project work (16 weeks)

4.1 The students pursuing the course UC3001-1 shall submit the diary recordings of day-to-day activities to the concerned guide, reporting progress achieved in the course and seeking guidance to proceed with the internship. The interns should provide all the details to the guide so that he/she can discuss with the employer to make the internship successful.

4.2 The intern should constantly update the guide about the progress of the internship. The guide should know the intern’s internship tasks, duties, responsibilities, and potential projects. The evaluation of interns and their internship progress should be honest and constructive.

4.3 The hardcopy or softcopy of the diary maintained by the interns must be signed at regular intervals by the guide.

4.4 Regarding the intern’s feedback, the guides should propose changes in internship activities so that they are helpful to the internship.

4.5 Illustrations, drawings, photos, forms, samples, classified materials, etc., are to be included in the report only after obtaining the consent of the concerned authorities and should indicate the source of all such material. The final report should also be submitted to the place where the internship was carried out. The report should avoid a tone that is predominantly cynical or unduly critical of the employer or of those with whom the student intern has worked. The content of the report must be based on interns’ own work.

4.6 Continuous Internal Evaluation (CIE)

The guides should evaluate the interns using the following as well as any other appropriate methods;

a) Punctuality of intern.
b) Conduct and character.
c) Tactfulness and politeness with colleagues and the public.
d) Attitude regarding professionalism.
e) Inquisitiveness and eagerness to learn.
f) Research attitude.
g) Problem-solving techniques.

h) Innovation mindset.
i) Time management and meeting deadlines.
j) Receptiveness to feedback and critiques.
k) Ability to work in a team as a member.
l) Ability to work without supervision.
m) Supervisory skills and leadership skills.
n) Judgment and decision-making skills.
o) Writing skills, oral communication skills, technical communication skills, computer skills, analysis skills, and business writing skills.
p) Appropriateness of technical skills.
q) Familiarization with writing technical papers, standards, codes, etc.
r) Reading Behavioural attitude.
s) Outcomes.
t) Successes and failures experienced

4.7 Recommendation letter

The guide must state whether the intern,

a) Exceeded the expectations of the internship.
b) Met the expectations of the internship.
c) Did not meet the expectations of the internship.
d) Did work to a satisfactory level.
e) Did an unsatisfactory internship.

In the end, the guide should issue a recommendation letter.

4.8 Assessment of CIE marks

4.8.1 **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the internship, shall be based on the evaluation of the diary, presentation skill, and viva-voce in the ratio of 50:25:25.

4.8.2 **Interdisciplinary:** The CIE marks awarded for the internship, shall be group-wise at the institution level with the participation of all guides of the internship. Participation of external guide/s, if any, is desirable.

4.8.3 The CIE marks awarded for the internship, shall be based on the evaluation of the diary, presentation skill, and viva-voce in the ratio of 50:25:25.

4.9 Assessment of SEE marks

4.9.1 Single discipline: Contribution to the internship and the performance of each group member shall be assessed individually in the semester-end examination (SEE) conducted at the department. Marks shall be awarded based on the evaluation of the report, presentation skill, and viva-voce in the ratio of 50:25:25.

4.9.2 Interdisciplinary: Contribution to the internship and the performance of each group member shall be assessed individually in the semester-end examination (SEE) conducted separately at the departments to which the student/s belongs. Marks shall be awarded based on the evaluation of the report, presentation skill, and viva-voce in the ratio of 50:25:25.

4.10 Evaluation of research Internship/Extended Industry Internship/Project Work:

Split-up of marks for evaluation of Project work for 100 CIE marks and 100 SEE marks

Split up	Rubrics		Marks
Report (50 Marks)	Content Development	Abstract/ Synopsis Write-up	10
		Selection of Topic/ Relevance of the subject to the concerned discipline	05
		Problem Identification	05
		Objectives and Methodology	05
	Problem-Oriented Exposition	Literature Survey (Papers/Sites/Sources Surveyed)	10
		Documentation/ Systematic Approach	10
		Results (with inferences, Conclusions, etc.)	05
Project Presentation Skill (25 Marks)		Quality of preparation of presentation	05
		Communication Skills	05
		Technical knowledge and awareness	05
		Individual involvement	10
Viva- Voce (25 Marks)		The clarity in answering questions relating to fundamentals and concepts	10
		The clarity in answering the questions related to the project	05
		The understanding ability of the questions asked	05
		The confidence in answering the questions asked.	05
		Total Marks	100

B.Tech. Syllabus

Effective from

Academic Year

2023 – 2024

Curriculum for Acquiring Professional Skills (CAPS)

With Scheme of Teaching & Examination

Scheme & Syllabus for
B. Tech. (Mechanical Engineering)

FIRST YEAR COURSES

DEPARTMENT OF MECHANICAL ENGINEERING
2023-24

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC
Off-Campus Centre, Nitte - 574 110, Karnataka,India

B.Tech. in Mechanical Engineering

Vision:
To produce Mechanical engineers of the highest quality who are professionally competent and highly qualified to suit the needs of industries and organizations by promoting excellence in teaching, learning and research.

Mission:
The Dept. of Mechanical Engineering is committed to –

- Provide high quality education to the students, to ful-fill the requirements of a 'Global Engineer'.
- Constantly strive to improve the teaching-learning methods, in order to deliver good academic programs.
- To respond to the fast evolving scientific and technological challenges in a highly competitive world.
- To inculcate, ethics, integrity, honesty, credibility, social and environmental consciousness.

Program Educational Objectives (PEOs):

PEO1: Be able to research, design, develop, test, evaluate, and implement engineering solutions to problems that are of a complexity encountered in professional practice.
PEO2: Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments.
PEO3: Consider the ethical implications and societal impacts of engineering solutions.
PE04: Continuously improve through lifelong learning.

Program Outcomes (POs):

Engineering Graduates will be able to:

Programme Outcomes (PO) and Programme Specific Outcomes (PSO)s for Department of Mechanical Engineering (U.G)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
P04	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Programme Outcomes (PO) and Programme Specific Outcomes (PSO)s for Department of Mechanical Engineering (U.G)	
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6.	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
P09	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environment.
PO12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: An ability to apply the concepts and principles of design and to develop solutions to real world problems useful to industries and society in general, which are ethically right, economically sound and environmentally sustainable.
PSO2: Understand and apply thermal engineering principles in solving problems related to the domain, to improve efficiency, reduce losses and pollution and effectively harness different forms of renewable sources of energy for the betterment of future generations.
PSO3: Understand the importance of manufacturing process and its role in industrial development and provide knowledge about the basics and advances to improve productivity.

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

Off-Campus Centre, Nitte - 574 110, Karnataka,India

B. Tech. in Mechanical Engineering

CREDIT DISTRIBUTION

No.	Course Category	Credit Range	Suggested Credits
1.	Basic Science Courses (BSC)	18-23	22
2.	Engineering Science Courses (ESC)	10-15	13
3.	Emerging Technology Courses (ETC)	03-05	03
4.	Programming Language Courses (PLC)	03-05	03
5.	Professional Core Courses (PCC)	52 - 58	55
6.	Professional Elective Courses (PEC)	12-18	15
7.	Open Elective Courses (OEC)	6	6
8.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
9.	Ability Enhancement Courses (AEC)	9	9
10.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
11.	Holistic Education Courses (HEC)	2	1
12.	Vocational Education Courses (VEC)	1	1
13.	Project Work (PROJ) (UCC)	10-12	10
14.	Internship (INT) (UCC)	8-12	10
15.	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

Off-Campus Centre, Nitte - 574 110, Karnataka,India

Course Numbering Scheme

Branch Code		Course Level	Course Code			Separator	Version
Letter	Letter	Number	Number	Number	Number	-	Number

Branch Code	ME is 2 Letter code for the Department of Mechanical Engineering
Course Level	Course Level is a 1-digit number that can have a value between 1-4 and indicates the prerequisite of a course. Level-1 courses are basic courses with no courses as pre-requisites Level-2 course(s) have Level-1 course(s) as prerequisites Level-3 course(s) have Level-2 course(s) as prerequisites Level-4 course(s) have Level-3 course(s) as prerequisites
Course Code	Course Code is a 3 Digit number that can have a value between 001-999 and indicates the number assigned to a course based on the following guidelines 001-199 is assigned to Professional Core Courses 001-099 for Integrated Professional Core Courses [4 Credit] 101-199 for Professional Core Theory Courses [3 Credit] 201-499 for Professional Elective Courses 201-299 Electives under Group I 301-399 Electives under Group II 401-499 for future use 501-550 for Open Elective Courses 551 – 599 for Vocational Education Courses 601-650 for Professional Core Lab Courses [1 Credit] 651-699 for Ability Enhancement Courses 701-799 for Courses offered to Honours Program
Separator	"_" is used as a separator between the Course code and the version
Version	Version is a 1-digit number that can have a value between 1-9 and indicates minor revisions of the same course.

I /IISEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**			**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**					
1	BSC	MA1005 – 1	Matrix Algebra and Differential Equations	MAT	3	0	0	3	50	50	100	3
2	BSC	CY1006-1	Chemistry of Engineering Materials	CHE	3	0	2	3	50	50	100	4
3	ESC	ME1003-2	Elements of Mechanical Engineering	ME	3	0	0	3	50	50	100	3
4	ESC	EE1002-1	Basic Electrical and Electronics Engineering	EE	3	0	0	3	50	50	100	3
5	ETC	ME1008-1	Introduction to Internet of Things (IoT)	ME	3	0	0	3	50	50	100	3
6	AEC	CS1002-1	IT Skills	Any Dept.	1	0	2	3	50	50	100	2
7	ESC	ME1001-1	Engineering Skill Development Practice	ME	0	0	2	2	50	50	100	1
8	AEC	BT1651-1	Biology for Engineers	BT	1	0	0	1	50	50	100	1
9	MNC	CV1002-1	Environmental Studies	CV	1	0	0	1	50	0	50	0
				TOTAL	**18**	**0**	**6**	**22**	**450**	**400**	**850**	**20**

Mandatory Internship-I*								
10.	INT	UC1001-1	Internship – I	Mandatory Intra Institutional Internship of duration (80 - 90 Hours) to be completed during I & II Semesters. *The grades will be included in the IV semester grade card (Refer 11.5.2 for details)	100	--	100	2

I/II SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**			**Examination**				
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	**Credits**
					L	**T**	**P**					
1	BSC	MA1008 – 1	Calculus and Laplace Transforms	MAT	4	0	0	3	50	50	100	4
2	BSC	PH1007-1	Physics of Materials	PHY	3	0	2	3	50	50	100	4
3	ESC	ME1002-1	Computer Aided Engineering Graphics	ME	2	0	2	3	50	50	100	3
4	ESC	CV1003-1	Engineering Mechanics	CV	3	0	0	3	50	50	100	3
5	PLC	CS1005-1	Introduction to Python Programming	ME	2	0	2	3	50	50	100	3
6	HSMC	HU1001-1	Technical English	HU	1	0	2	3	50	50	100	2
7	MNC	HU1002-1	Constitution of India	HU	1	0	0	1	50	0	50	0
8	BSC	MA1006 - 1	Mathematics with MATLAB	MAT	0	0	2	1	50	0	100	1
				TOTAL	**16**	**0**	**8**	**20**	**400**	**300**	**750**	**20**

MATRIX ALGEBRA & DIFFERENTIAL EQUATIONS

Course Code:	**MA1005 - 1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**4:0:0:0**	**Credits:**	**04**
Total Teaching Hours:	**50+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1.	This course will enable the students to master the basic tools of elementary linear algebra, infinite series, differential equations, multiple integration and become skilled for solving problems in science and engineering.

UNIT-I

Matrices — **12 Hours**

Elementary transformation of a matrix, Echelon form and rank of a matrix. Consistency and solution of system of linear equations: Gauss elimination method and LU-decomposition method. Iterative method: Gauss Seidel method. Eigen values and eigen vectors of square matrices, Rayleigh's power method to find the largest eigen values and eigen vectors of square matrices.
Applications: Structural Analysis, Balancing equations.

UNIT-II

Sequences and Series — **8 Hours**

Convergence and divergence of infinite series. Tests for convergence of positive term series-comparison test, D-Alembert's ratio test and Cauchy's root test. Power series- Taylor's theorem for a function of single variable with remainder(without proof), expansion of functions into Taylor's and Maclaurin's series.
Applications: Computation of stress and strain.

UNIT-III

First Order Ordinary Differential Equations — **10 Hours**

Exact, linear and Bernoulli's differential equations, orthogonal trajectories of cartesian and polar curves. Applications to simple engineering problems. Nonlinear differential equations (first order and higher degree) equations solvable for p, equations solvable for y and equations solvable for x, general and singular solutions of Clairaut's equations.
Applications: Rate of growth or decay, conduction of heat

UNIT-IV

Ordinary Differential Equations of Higher Order — **10 Hours**

Second and higher order linear differential equation with constant coefficients, solution by inverse differential operator, method of variation of parameters, linear differential equation with variable coefficients- Cauchy's linear differential equation. Applications to engineering problems.
Applications: Oscillations of spring, Transmission lines, Highway engineering.

UNIT-V

Multiple Integrals — **10 Hours**

Double integrals and triple integrals, evaluation by change of order of integration, change of variables and applications to area and volume. Beta and Gamma functions and their properties.
Applications: Applications to mathematical quantities (Area, surface area, volume), Analysis of probabilistic models.

Course Outcomes: At the end of the course student will be able to

1.	Solve the system of linear equations and find eigen values and eigen vectors of the given matrix.
2.	Develop the power series of the given function and understand the concept of convergence and divergence of series.
3.	Solve first order ordinary differential equations.
4.	Solve linear ordinary differential equations of higher order.
5.	Apply the notion of multiple integrals to find areas and volumes.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2
MA1005 - 1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1005 - 1.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1005 - 1.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
MA1005 - 1.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1005 - 1.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley and Sons, 10th Edition (Reprint), 2016.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publications, 43rd Edition, 2015.

REFERENCE BOOKS:

1. T. Veerarajan, “Engineering Mathematics”, McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, “Higher Engineering Mathematics”, Tata Mc Graw –Hill, New Delhi,2010.
3. N.P. Bali and M.Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
4. W.E. Boyce and R.C. DiPrima, “Elementary Differential Equations and Boundary Value Problems”, Wiley India, 2009.
5. E.A. Coddington, “An Introduction to Ordinary Differential Equations”, Prentice Hall India, 1995.
6. G.F. Simmons and S.G. Krantz, “Differential Equations”, McGraw Hill, 2007.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/courses/111107108/
2. https://nptel.ac.in/courses/122101003

CHEMISTRY OF ENGINEERING MATERIALS

Course Code:	**CY1006-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Chemistry

Course Objectives:

1.	To enable students to acquire knowledge on principles of chemistry for engineering applications.
2.	To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.

3.	To provide students with a solid foundation in analytical reasoning required to solve societal problems.

UNIT-I

Energy Conversion and Storage	**7 Hours**

Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Na-ion battery, Li-ionbattery,and flow battery (Vanadium redox flow battery).
Fuel Cells: Introduction, construction, working and applications of methanol–oxygen and polymer electrolyte membrane (PEM) fuel cell.
Solar Energy: Introduction, importance of solar PV cell, construction and working of solar PV cell, Advantages and disadvantages.

Corrosion science and engineering	**8 Hours**

Corrosion: Introduction, electro-chemical theory of corrosion, types of corrosion-differential metal, differential aeration (waterline and pitting), stress corrosion (caustic embrittlement).
Corrosion control: Metal coating-galvanization, surface conversion coating-anodization and cathodic protection-sacrificial anode method. Corrosion testing by weight loss method. Corrosion penetration rate (CPR)-numerical problems.
PCB: Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB.

UNIT-II

Sensors in Analytical Techniques	**9 Hours**

Electrode System: Introduction, types of electrodes. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Concentration cell-Definition, construction, working and Numerical problems. Ion selective electrode-definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Concentration cell-Definition, construction, and Numerical problems.
Sensors: Introduction, working principle and applications of Conductometric sensors, Electro chemical sensors, Thermo-metrics sensors, and Optical sensors.
Analytical techniques: Principle and instrumentation of Conductometry; its application in the estimation of weak acid and strong acid. Principle and instrumentation of Potentiometry; its application in the estimation of iron.

	6 Hours

Polymers:
Polymers: Introduction, molecular weight; number average and weight average, numerical problems. Synthesis, properties, and industrial applications of polystyrene, poly (methyl methacrylate) (PMMA).
Elastomers: Introduction, synthesis, properties, and industrial applications of Butyl rubber.
Adhesives- Synthesis and applications of Epoxy resins.
Polymer Composites: Introduction, synthesis, properties, and applications of kevlar.
Lubricants: Introduction, classification, properties, and applications of lubricants.
Phase rule: Introduction, Definition of terms: phase, components, degree of freedom, Phase rule equation. Phase diagram: Two component-lead-silver system.

UNIT-III

Nanomaterials and Display Systems	**10 Hours**

Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting), preparation of nanomaterials by sol-gel and co-precipitation method with example. Introduction, properties, synthesis, and applications carbon nano tubes.
Display Systems: Liquid crystals (LC's)-Introduction, classification, properties, and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).
Perovskite Materials: Introduction, properties, and applications in opto-electronic devices.

E-waste Management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of copper and gold from e-waste.

Suggested List of Experiments

1.	Determination of strength of an acid in Pb-acid battery (Demonstration).
2.	Determination of Total Hardness of a sample of water using disodium salt of EDTA.
3.	Estimation of iron in TMT bar by diphenyl amine/external indicator method.
4.	Synthesis of polyurethane (Demonstration).
5.	Conductometric estimation of strong acid with standard NaOH solution.
6.	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$solution.
7.	Determination of pKa of vinegar using pH sensor (Glass electrode).
8.	Determination of the viscosity coefficient of a given liquid using Ostwald's viscometer.
9.	Estimation of Copper present in electroplating effluent by optical sensor (colorimetry).
10	Colorimetric determination of iron.
11	Conductometric estimation of a weak acid using standard NaOH solution.
12	Estimation of Sodium present in soil/effluent sample using flame photometer.
13	Synthesis of biodiesel (Demonstration).
14	Synthesis of Iron-oxide Nano particles (Demonstration).

Course Outcomes: At the end of the course student will be able to

1.	Identify the terms processes involved in scientific and engineering and applications.
2.	Explain the phenomena of chemistry to describe the methods of engineering processes.
3.	Solve the problems in chemistry that are pertinent in engineering applications.
4.	Apply the basic concepts of chemistry to explain the chemical properties and processes.
5.	Analyze properties and multi processes associated with chemical substances in disciplinary situations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
CY1006-1.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1006-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1006-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1006-1.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1006-1.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. P. C. Jain & Monica Jain, "Engineering Chemistry", Dhanpat Rai Publications, New Delhi, 2015.
2. R. V. Gadag and Nityananda Shetty, "A Text Book of Engineering Chemistry", 2nd Edition, I. K. International Publishing house, 2016.
3. S. S. Dara & S. S. Umare, "A Textbook of Engineering Chemistry", 12th Edition, S. Chand & Company Ltd., 2011.

REFERENCE BOOKS:

1. Baskar, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2. Satya Prakash & Manisha Agrawal, "Engineering Chemistry", Khanna Book Publishing, Delhi.
3. Bahl & Tuli, "Essentials of Physical Chemistry", S. Chand Publishing.
4. Sunita Rattan, "Applied Chemistry", Kataria.
5. D. Grour Krishana, "Engineering Chemistry – I", Vikas Publishing.
6 F. W. Billmeyer, "Text Book of Polymer Science", John Wiley & Sons, 4th Edition, 1999.

7	G. A. Ozin & A. C. Arsenault, “Nanotechnology A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
8	Kirby W. Beard, “Linden's Handbook of Batteries”, Fifth Edition, Mc GrawHill, 2019.
9	Takatoshi Tsujimura, “OLED Display Fundamentals and Applications”, Wiley–Blackwell, 2012.
10	MaxLu, Francois Beguin, Elzbieta Frackowiak, “Super capacitors: Materials, Systems, and Applications”, Wiley-VCH;1st edition, 2013.
11	H. Panda, “Handbook on Electroplating with Manufacture of Electro-chemicals”, ASIAPACIFIC BUSINESS PRESS Inc., 2017.
12	Sudharani, “Laboratory manual in Engineering Chemistry”, Dhanpat Rai Publishing Company, New Delhi.
13	“Expanding the Vision of Sensor Materials”, National Research Council 1995, Washington, DC: The National Academies Press. doi:10.17226/4782.
14	Mahesh B and Roopa Shree B, “Engineering Chemistry”, Sunstar Publisher, Bengaluru, ISBN978-93-85155-70-3, 2022
15	F. H. Froes,et al., “High Performance Metallic Materials for Cost Sensitive Applications”, John Wiley & Sons, 2010.
16	K. R. Mahadik and L. Satyanarayana, “Instrumental Methods of Analysis”, Nirali Prakashan, 2020.
17	Douglas A. Skoog, F. James Holler, Stanley R. Crouch, “Principles of Instrumental Analysis”, Seventh Edition, Cengage Learning, 2020.
18	V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, “Polymer Science”, NewageInt. Publishers, 4th Edition, 2021.
19	Hari Singh, “Nanostructure materials and nanotechnology”, Nalwa, Academic press, 1st Edition, 2002.
20	O. G. Palanna, “Engineering Chemistry”, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.

E Books / MOOCs/ NPTEL

1.	http://libgen.rs/ • https://nptel.ac.in/downloads/122101001/
2.	https://nptel.ac.in/courses/104/103/104103019/ • https://ndl.iitkgp.ac.in/.
3.	https://www.youtube.com/watch?v=faESCxAWR9k

COMPUTER AIDED ENGINEERING GRAPHICS

Course Code:	**ME1002-1**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**25+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To impart and inculcate understanding of the theory of projection and concepts like dimensioning, conventions and projection of points and lines in different quadrants of projection system. To know and understand the projection of different plane surfaces.
2.	To impart the knowledge on understanding and drawing of different solid objects in different positions.
3.	To develop the lateral surfaces of solid objects and its use in sheet metal development. To draw isometric projection of solid objects individually or in combination

UNIT-I

Orthographic Projection	**06 Hours**
Orthographic Projection: Planes of Projection, First angle projection, reference line. Conventions employed for drawing, Projection of points located in first, second, third and fourth quadrants, Projection of Lines (First angle projection only), True and apparent lengths, true and apparent inclinations.	
Projection of Plane surfaces	**10 Hours**
Projection of plane surface: Triangle, Square, Rectangle, Pentagon, Hexagon and Circle in different positions.	
UNIT-II	
Projection of Solids	**15 Hours**
Projection of right regular solids: Prisms, Pyramids, Cones, and Cylinders in different positions.	
UNIT-III	
Development of Lateral surfaces of solids	**10 Hours**
Development of lateral surfaces of: Right regular Prisms, Pyramids, Cylinders and cones and their frustums.	
Isometric projection and Isometric view	**10 Hours**
Isometric scale, Difference between Isometric projection, and isometric view: To draw Isometric views of simple solids and machine components using their orthographic projections.	

Course Outcomes: At the end of the course student will be able to

1.	Identify a coordinate system in which a point element exists. Draw the orthographic projections of a point and a line. Draw the orthographic projections of a plane surface (Triangular, square, rectangular, pentagonal, hexagonal and circular) for a given position using conventional drafting method and Solid Edge software.
2.	Draw the orthographic projections of a solid object (Pyramid, Prism, Cubic, Conical, cylindrical) for a given position using conventional drafting method and Solid Edge software.
3.	Draw the development of lateral surfaces of standard solid objects. Draw isometric projection of solid objects individually or in combination using conventional drafting and Solid Edge software.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1002-1.1	3	1	0	0	0	0	0	0	1	1	0	2	2	1	2
ME1002-1.2	3	1	0	0	3	0	0	0	1	1	0	2	2	1	2
ME1002-1.3	3	1	0	0	3	0	0	0	1	1	0	2	2	1	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	N. D. Bhat & V. M. Panchal, Pramod R. Ingle, "Engineering Drawing", 53rd Edition, Charotar Publishing House, Gujarat, 2014.
2.	K. R. Gopalakrishna, "Engineering Drawing", Subhas publishers, Bangalore, 32nd edition, 2012.

REFERENCE BOOKS

1.	P. S. Gill, "A Text book of Engineering Graphics and Drafting", 11th Edition, S. K. Kataria & sons, New Delhi, 2009.

2.	K. L. Narayanan & Kannaiah P, “A Text book of Engineering Drawing”, Radiant Publishing House, 9th Edition, 2012.
3.	“A Primer on computer aided Engineering Drawing”, VTU, Belgaum, 8thEdition, 2011.
4.	“Engineering Drawing and Computer Graphics”, Shah, Pearson, 2010.
5.	Narayana, “Textbook on Engineering Drawing”, Scitech Publishers, 1 December 2011.
6.	Agarwal & Agarwal, “Engineering Graphics”, TMH, Second edition, 2013.
7.	Publications of Bureau of Indian Standards a) IS 10711 – 2001: Technical products documentation – Size and lay out of drawing sheets. b) IS 9609 (Parts 0 & 1) – 2001: Technical products documentation – Lettering. c) IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings. d) IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings. e) IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code:	**EE1002-1**	**Course Type**	**ESC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electrical and Electronics Engineering

Course Objectives:

1.	To get familiarized with the DC circuit analysis.
2.	To understand the working principle of transformer and electrical machines.
3.	Understand the working of Semiconductor Diodes, Zener Diodes and its applications.
4.	Understand the construction, working and characteristics of diodes, BJT and MOSFET
5.	Understand the working of Op-Amp and their applications

UNIT-I

Circuit Fundamentals	**08 Hours**

Basic nodal and mesh analysis excited by independent DC voltage sources, Power and Energy. Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities.
Analysis of R, L, C, R-L, R-C and R-L-C series and parallel circuits. Phasor Diagrams. Real power, reactive power, apparent power and power factor.

Transformers and electrical machines	**08 hours**

Transformers: Necessity of transformer, principle of operation, Types and construction of single-phase transformers, EMF equation, losses, variation of losses with respect to load. Efficiency (simple numerical)
DC Motor: Principle of operation, back emf and its significance. Torque equation, types of motors, characteristics and speed control (armature & field) of DC motors (series & shunt only). Applications of DC motors (simple numerical)

Three-phase induction Motors: Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel cage and wound rotor. Slip and its significance (simple numerical)

UNIT-II

Diodes, Transistors and their applications	**16 Hours**

Semiconductor Diode, Diode Equivalent circuits, Half Wave Rectifier, Full wave Bridge Rectifier, capacitor, and choke filter circuit (only qualitative approach). Zener Diode and its use in Voltage Regulation.

Bipolar Junction Transistor: Construction and operation, Common Emitter and Common Base Characteristics, DC load line analysis, RC coupled amplifier (frequency response excluded), BJT as a switch, BJT circuit to switch ON/OFF an LED. Field Effect Transistor, Enhancement mode MOSFETs, CMOS Inverter.

UNIT-III

Op-Amp & Linear IC Applications	**08 Hours**

Introduction, Op-Amp Specifications, Differential & Common-Mode operation, Op-Amp applications: Inverting/Non-Inverting Amplifier, Summing, Integrator, Differentiator, Comparator. 555 Timer IC in Astable mode. 78XX series IC Voltage Regulators.

Course Outcomes: At the end of the course student will be able to

1.	Analyse DC and AC circuits to determine circuit parameters
2.	Describe the construction, operating principle of Transformers, DC & Induction motors to study performance characteristics.
3.	Analyze characteristics of p-n junction and Zener diode to understand their operation in specific applications
4.	Describe the construction and operation of BJT and FET to operate it as a switch
5.	Describe the basic building blocks of Op-Amp and signal processing circuits to design Op-Amp for timing circuits

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓	
↓ Course Outcomes													1	2
EE1002-1.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1002-1.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1002-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1002-1.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1002-1.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Hughes, Edward, "Electrical Technology", Pearson Education Publications, 10th Edition, 2010.
2.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 3rd Edition 2009.
3.	Robert L Boylestad Louis Nashelsky, "Electronic Devices and circuit theory", 11th Edition, PHI, 2016.

INTRODUCTION TO INTERNET OF THINGS (IOT)

Course Code:	**ME1008-1**	**Course Type**	**ETC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and processes.

1.	Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
2.	Understand the recent application domains of IoT in everyday life.
3.	Gain insights about the current trends of Associated IOT technologies and IOT Analytics

UNIT-I

Basics of Networking — **08 Hours**

Introduction, Network Types, Layered network models

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components

IoT Sensing and Actuation — **08 Hours**

Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

UNIT-II

IoT Processing Topologies and Types — **08 Hours**

Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

Associated IoT Technologies — **08 Hours**

Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.

IoT case studies:

Agricultural IoT – Introduction and Case Studies

UNIT-III

IoT Case Studies and Future Trends — **08 Hours**

Vehicular IoT – Introduction
Healthcare IoT – Introduction, Case Studies
IoT Analytics – Introduction

Course Outcomes: At the end of the course student will be able to

1.	Describe the evolution of IoT, IoT networking components, and addressing strategies in IoT, Classify various sensing devices and actuator types.
2.	Demonstrate the processing in IoT, Explain Associated IoT Technologies
3.	Illustrate architecture of IoT Applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1008-1.1	3	1	-	-	-	1	-	1	-	1	-	-	-	-	-
ME1008-1.2	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1008-1.3	3	2	-	-	-	-	-	-	-	1	-	-	-	-	-

ME1008-1.4	3	2	-	-	-	-	-	-	1	1	-	-	-	-	-
ME1008-1.5	3	2	-	-	-	-	-	1	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press, 2021.

REFERENCE BOOKS:

1.	S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, 2020.
2.	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

TECHNICAL ENGLISH

Course Code	**HU1001-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T:P)	**1:0:2**	**Credits**	**02**
Total Teaching Hours	**13+0+26**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Identify the nuances of Phonetics, Intonation and enhance pronunciation skills
2.	Understand Technical Communication along with the barriers and application of effective Interpersonal Communication Skills
3.	Enhance basic English grammar and essentials of language skills
4.	Improve sentence structure with the help of cohesive devices
5.	Develop spoken and writing skills

UNIT - I

Phonetics & Pronunciation	**8 Hours**

Introduction to Phonetics; Word Stress, Rhythm, and Intonation; Weak Forms and
Strong Forms, Role of IPA in past tense and plural forms of words, Awareness of Different Accent

Communication Skills	8 Hours

Introduction to Communication, Greeting and Introducing, Making Requests, asking for and Giving Permission, Offering Help. Understanding Telephone Communication, Handling Calls, asking for and Giving Information, Telephone Etiquette

UNIT - II

Language Skills	15 Hours

Basic English Grammar, Ability to identify, Analyze, Interpret and Describe the critical ideas, values, and themes through literary works

UNIT - III

Writing Skills	8 Hours

Paragraph writing, Refutations, Linkers, Types of Letters

Course Outcomes: At the end of the course student will be able to

1.	Identify the nuances of phonetics, intonation and pronunciation to appreciate and incorporate Received Pronunciation
2.	Interpret and assess nuances of oral communication skills and the non-verbal communication for professional usage
3.	Identify, interpret and describe the critical ideas, values, and themes to appreciate literary pieces for its language and social interpretations
4.	Implement English vocabulary at command and language proficiency in personal and professional life
5.	Develop effective writing skills for incorporating them in different forms of writing

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓	
↓ Course Outcomes													1	2
HU1001-1.1	1	1	-	-	-	-	-	2	-	2	-	3	-	-
HU1001-1.2	2	-	-	-	-	2	-	-	-	3	-	3	-	-
HU1001-1.3	-	2	-	-	-		3	2	-	3	-	3	-	-
HU1001-1.4	-	2	-	-	-	2	-	-	2	2	-	2	-	-
HU1001-1.5	-	2	-	-	-	2	-	2	1	2	-	2	-	-

1: Low 2: Medium 3: High

TEXT BOOK:

1.	Subhashini, A Textbook of English Language & Communication Skills, R Victor et al.

REFERENCE MATERIALS:

1.	English Pronunciation Dictionary, Daniel Jones A Remedial English Grammar for Foreign Students, Woods
2.	Communication Skills, Sanjay Kumar, Oxford University Press.
3.	Exercises in Spoken English Part I - CIEFL, Hyderabad, Oxford University Press.
4.	Exercises in Spoken English Part II - CIEFL, Hyderabad, Oxford University Press.
5.	Exercises in Spoken English Part III - CIEFL, Hyderabad, Oxford University Press.
6.	On Writing Well, William Zinsser
7.	Practical English Usage, Swan, Oxford University Press.
8.	Study Writing, Liz-Hamp Lyons, Cambridge University Press

E Resources

1.	https://www.macmillandictionary.com/dictionary/british/

ENGINEERING SKILL DEVELOPMENT PRACTICE

Course Code:	**ME1001-1**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and process.

1.	Prepare simple fitting and carpentry models by using workshop hand tools. Fabricate a simple metallic frame using drilling machine, angle grinder, chop saw machine and welding.

2.	Prepare carpentry models using carpentry tools and sheet metal models of simple solids using soldering tools.
3.	Understand how to assemble/ disassemble machine parts such as machine vice and deadbolt door lock on a wooden block.
4.	Understand the basic principles of power transmission such as calculation of velocity ratio of belt drive along with theoretical and actual speed of driven shaft of stepped cone pulley.
5.	Understand how to assemble automatic Linear actuator using Power tools/ power tool kit

UNIT-I

Fitting Shop/ Carpentry Shop/ Metal fabrication processes — **10 Hours**

Fitting: Study and use of engineering steel rule, height gauge, caliper, micrometer, files, chisels, hacksaw, hammers, drill bit, taps etc. Models: Preparation of fitting models by making use of filing, sawing and chipping. (1 Model among square fitting, V fitting and dovetail fitting joints).
Carpentry: Study the use of carpentry tools and joints. Model: 1 model (Dovetail Joint)
Metal Fabrication Processes
Fabrication of simple frames using a magnetic drilling machine, chop saw machine, angle grinder with slider, Jig saw machine and MIG/ TIG welding processes

UNIT-II

Plumbing - Pipes and Pipe Fitting — **10 Hours**

Selection and use of different pipes like GI Pipes, Plastic pipes, PVC pipes, HDPE pipes, Cast iron pipes, Plumbing symbols / accessories; Bends, Elbows, Sockets, Tees, Unions, Pipe cutting, Pipe bending, Pipe Threading, Pipe joints, Pipe fitting, Alignment of pipes, Branching of pipes, Safety precautions, relevant IS codes are to be taught.
List of Experiments:

1. Identification of type of pipe and type of plumbing accessories
2. Development of pipe fitting as per drawing
3. Alignment of pipes with level on the wall surface
4. Pipe threading and preparing pipe joints as per drawings

Sheet metal Work and Soldering/ Electrical Wiring

Study the development of surfaces of simple solids like prism, cylinder and cone.
Models: Preparation of two sheet metal models (square/ rectangular prism and cylinder).
Electrical wiring exercises – Electrical circuit of one-way and two-way switch operation.

UNIT-III

Demonstration/ Active learning — **06 Hours**

Calculation of speed/ velocity ratio of a V belt of a drilling machine
Assembly/ Disassembly of a machine part such as the machine vice/ tailstock of a lathe.
Assembly and actuation of a XY slide/ Linear actuator.

Course Outcomes: At the end of the course student will be able to

1.	Prepare fitting models/ metallic frame by using required tools and operations.
2.	Draw the development of sheet metal models and prepare sheet metal models using the required tools and soldering operation. Construct the necessary circuit and to operate a one-way/ two- way switch. Identify the required components and prepare a plumbing joint as per the given drawing.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
ME1001-1.1	3	1	-	-	-	1	-	1	3	1	-	-
ME1001-1.2	3	1	-	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	K. R. Gopalkrishna, "A text Book of Elements of Mechanical Engineering", Subhash Publishers, Bengaluru, 2010.
2.	Mikell P. Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI, 2012.
3.	V. K. Manglik, "Elements of Mechanical Engineering", PHI Publications, 2013.
REFERENCE BOOKS	
1.	S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 4th Edition 2006, Universities Press (India) Pvt. Ltd, Hyderabad.
2.	K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt Ltd, Mumbai,7th Edition,2012.
3.	Pravin Kumar, "Basic Mechanical Engineering", 2013 Edition, Pearson.
4.	G. S. Sethi, "Plumber", Computech Publications Ltd, New Delhi (Available in English and Hindi)
E Books / MOOCs/ NPTEL	
1.	https://nidm.gov.in/iec.asp (Study material of National Institute of Disaster management)
2.	e-books/e-tools/relevant software to be used as recommended by AICTE/ UBTE/ NITTTR, Chandigarh on plumbing

BIOLOGY FOR ENGINEERS

Course Code:	**BT1651-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn the types of cells, biomolecules, and life processes
2.	To know the applications inspired by nature in various streams
3.	To be updated application of biology in real life scenarios.

UNIT-I

Introduction For Biology for Engineers	05 Hours

Why Biology for Engineers? Cell Types & Properties: Prokaryotes - Bacteria, Viruses and Fungi, Eukaryotes - Plant and Animal Cells, Biomolecules, Life Processes at Cellular Level.

UNIT-II

Applications Inspired by Nature	05 Hours

Composites in Construction, Termite Mound architecture, Counter current heat exchangers, Design of aeroplane, helicopter and submarine, Information Theory and Biology, SONAR, Medical Devices.

UNIT-III

Real Life Scenarios	05 Hours

Recent scenarios in Environment, Agriculture and Medical Technology.

Course Outcomes: At the end of the course student will be able to

1.	Ascertain the importance of Biology to be applied in various engineering streams
2.	Interpret the basics of cell and life processes
3.	Draw inspiration nature in design of machinery and construction
4.	Analyze the significance of mimicry of nature in design of electrical, electronic, and medical devices
5.	Judge knowledge on recent advances in application of biology to Environment, Agriculture and Medical Technology

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12

BT1651-1.1	3	-	-	-	-	-	-	-	1	-	-	1
BT1651-1.2	3	-	-	-	-	-	-	-	1	-	-	1
BT1651-1.3	3	3	-	-	-	-	2	-	1	-	-	1
BT1651-1.4	3	3	-	-	-	-	2	-	1	-	-	1
BT1651-1.5	3	3	-	-	-	-	2	-	1	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Suraishkumar, G.K. Biology for Engineers, Oxford University Press India, 2019.
2.	Chakraborty, T, Akthar, N Biology for Engineers, PHI learning Print Book ISBN: 9789391818142 eBook ISBN: 9789391818197

REFERENCE BOOKS:

1.	Rao C.V., Biology for Engineers, 2021
2.	Raven, P. H. and Johnson, G. B. Biology. 4th Ed. WCB publishers, 2010.
3.	Ethier, R. S. and Simmons, C. A. Introductory biomechanics- From cells to organisms. Cambridge University Press, 2012

ENVIRONMENTAL STUDIES

Course Code:	**CV1002-1**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P)	**1:0:0**	**Credits**	**00**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks**	**50+00**

Teaching Department: Civil Engineering

Course Objectives:

1.	To raise consciousness about environmental conditions and to imbibe environmentally appropriate behaviour.
2.	To equip the engineering undergraduates to identify the significance of environmental practice in their daily life and in the engineering practices.
3.	To make them conscious of understanding the environment where we live and act up on.

UNIT-I

03 Hours

Environment

Definition, significance of environmental studies- current scenario, local, regional, national and global problems

Components of environment: atmosphere, hydrosphere, lithosphere, and biosphere. Layers of atmosphere and its role.

Parts of Earth- lithosphere and its role; hydrological cycle

Eco system - Definition, ecology and environment, ecosystem components: biotic and abiotic components; ecological balance; elements of ecosystem: biotic, abiotic; producers, consumers and decomposers.

Habitat, range of life, Biome, balanced eco- system, food chain, food web and ecological pyramids

Human activities - The Anthropogenic System- human activities like growing food, building shelter and other activities for economy and social security. Soil erosion, water logging -definition. Organic farming- definition.

Natural resources — **03 Hours**

Resources - Natural resources, water, minerals, Fossil fuels and energy

Water resources - Global water resources: distribution, uses of water for irrigation, domestic and industrial purposes in India.

Quality aspects - Water quality parameters, drinking water standards for turbidity, pH value, total hardness, iron, fluoride, lead, arsenic, nitrate

Mineral resources- Metallic minerals, non-metallic minerals Fossil fuels - Coal and petroleum

Forest Wealth - Components of the forest, key benefits of forests. Deforestation-environmental effects of deforestation and remedies Sustainable development- definition, objectives
Material cycles - Carbon, Nitrogen, and Sulphur cycles.

UNIT-II	
Environmental pollution: Definition, harmful effects related to public health	**03 Hours**
Water pollution: Definition, types, and sources – agriculture (pesticides and fertilizers), industry, domestic and mining, harmful effects, water borne and water induced diseases- definition, common diseases and their causatives, Fluoride problem in drinking water **Land pollution**: Definition, sources_ agriculture, housing, industry, mining, transportation. Types of municipal Solid waste Disposal (Sanitary landfills, composting, incineration (in brief) and effects **Air Pollution**: Definition, types, and sources: industry, mining, agriculture, transportation, and effects **Noise pollution**: Definition, sources, mining, industries, rail-roads, aviation, effects and control measures	
Energy	**02 Hours**
Different types of energy- Non-renewable energy; fossil fuels- coal, oil, and natural gas- brief description only. Nuclear energy- nuclear power plants, Renewable energy: solar energy- Photovoltaic systems for street and domestic lighting, solar water heating-brief description only Wind energy- definition, merits and demerits, Hydro power- definition, merits, and demerits. Biomass energy- definition, sources of bioenergy, biogas, biofuels, India's position in renewable energy Hydrogen as an alternative future source of energy- brief scope, fuel cells.	
UNIT-III	
Current environmental issues of importance	**04 Hours**
Population growth- Definition, growth rate, effects, remedies Urbanization- Definition, environmental impacts and remedies Global warming and climate change- Concept of greenhouse effect, sources of greenhouse gases, effects, and remedial measures of greenhouse gases Acid rain: Definition, causes and effects, control measures. Ozone Depletion: Definition, causes, effects, and control measures. Environmental Impact Assessment- EIA definition, objectives, and benefits of EIA.	

Course Outcomes: At the end of the course student will be able to

1.	Identify the significance of environmental practice in their daily life and in the Engineering practices.
2.	Create awareness about environmental conditions.
3.	Follow environmentally appropriate behaviour.
4.	Understand the importance of their surroundings.
5.	Understand Current environmental issues of importance

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
CV1002-1.1	-	2	-	-	-	-	-	2	-	-	-	-	1	-	-
CV1002-1.2	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-
CV1002-1.3	1	-	-		1	-	-	-	-	-	-	-	1	-	-
CV1002-1.4	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-

CV1002-1.5	-	-	3	-	-	-	-	-	-	-	3	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Benny Joseph, "Environmental Studies", Tata McGraw Hill Publ. Co., New Delhi, 2005.
2.	Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford University Press, London, 2005.

REFERENCE BOOKS:

1.	Balasubramanya, N and Chatwal, Gurdeep R., "Environmental Studies", Himalaya Publishing House, Mumbai, 2007.
2.	Barucha, E., "Environmental Studies", University Grants Commission, New Delhi, 2004.
3.	Bhatia, S. C., "Environmental Chemistry", CBS Publishers, New Delhi, 2005.
4.	De, A.K. and De, A. K., "Environmental Studies", 2006.
5.	Keller, Edward A., "Environmental Geology", CBS Publishers and Distributors, Delhi, 1985.

CALCULUS & LAPLACE TRANSFORMS

Course Code:	**MA1008 – 1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1.	This course will enable the students to master the basic tools of differential calculus, Laplace transforms, partial differential equations and become skilled for solving problems in science and engineering.

UNIT-I

Differential Calculus — **12 Hours**

Polar curves, angle between the radius vector and the tangent, angle of intersection of two curves. derivatives of arcs, radius of curvature - cartesian, parametric and polar forms. Rolle's Theorem (without proof), mean value theorems and applications to simple problems.
Applications: Structural design and paths, Strength of materials, Elasticity.

Partial Differentiation — **8 Hours**

Partial derivatives of simple functions, total differentiation - differentiation of composite and implicit functions, Jacobians. Taylor's theorem for functions of two variables, maxima and minima for functions of two variables, Lagrange's method of undetermined multipliers (with one subsidiary condition).
Applications: Estimating the critical points and extreme values.

UNIT-II

Laplace Transforms — **12 Hours**

Definitions, transforms of elementary functions, transforms of derivatives and integrals- properties. Periodic functions, unit step functions and unit impulse functions.
Inverse Transforms and properties, convolution theorem, initial & final value theorems. Applications to engineering problems.
Applications: solving the free vibration problems of structural beams.

UNIT-III

Partial Differential Equations	**08 Hours**

First and higher order partial differential equations. Formation of partial differential equations by elimination of arbitrary constants/arbitrary functions. Derivation of one dimensional heat and wave equations, Solution of PDE's by direct integration method, by the method of separation of variables, by Lagrange's Method. Solution of partial differential equations of derivatives involving only one independent variable.
Applications: Design of structures (vibration of rod / membrane)

Course Outcomes: At the end of the course student will be able to

1.	Apply the concept of radius of curvature and mean value theorems.
2.	Learn the concept of partial differentiation of a function with two or more independent variables, apply them to solve engineering problems and examine the given function for its extrema.
3.	Understand the concept of Laplace Transform and apply it to solve engineering problems.
4.	Make use of Laplace transform method to solve linear ordinary differential equations with constant coefficients
5.	Understand the derivation of one dimensional heat and wave equations and solve partial differential equations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
MA1008 – 1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1008 – 1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1008 – 1.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1008 – 1.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1008 – 1.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.

REFERENCE BOOKS:

1.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi,2010.
3.	N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
4.	G.B. Thomas and R. L. Finney, "Calculus and Analytic geometry", Pearson, 2002.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/111106100
2.	http://nptel.ac.in/courses/111106139
3.	http://nptel.ac.in/courses/111107111

PHYSICS OF MATERIALS

Course Code:	**PH1007-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L:T:P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Physics

Course Objectives:

1.	To understand the concepts of oscillations and resonance.
2.	To study the theory of elasticity.
3.	To understand the fundamentals of semiconductors.
4.	To study the concept of dielectrics.
5.	To understand the fundamentals of thermoelectric and magnetic materials.

UNIT-I

Oscillations — **08 Hours**

Introduction, Simple Harmonic motion (SHM), Differential equation for SHM (No derivation), Free, Damped and Forced oscillations, Resonance, coupled oscillations, Sprigs: Stiffness Factor and its Physical Significance, Series and Parallel combination of springs (Derivation), Types of Springs and their applications. Theory of Damped oscillations (Qualitative), Types of Damping (Graphical Approach). Engineering applications of Damped oscillations, Theory of Forced oscillations (Qualitative), Resonance, Sharpness of resonance. Numerical Problems.

Elasticity — **07 Hours**

Basics of elasticity, Stress-Strain Curve, Hook's law, Different Moduli of Elasticity, Poisson's ratio, Relation between Y, n and σ (with derivation), mention of relation between K, Y and σ, limiting values of Poisson's ratio. Torsion of a cylinder and determination of couple per unit twist – Torsion pendulum, Beams: Bending moment and derivation of expression, Cantilever and I section girder and their Engineering Applications, Elastic materials (qualitative), Numerical problems.

UNIT-II

Semiconductors — **8 Hours**

Introduction to semiconductors - intrinsic and extrinsic semiconductors - carrier generation. Direct and indirect band gap semiconductors. Fermi level in Intrinsic & Extrinsic Semiconductor and its behavior with temperature, Expression for concentration of electrons in conduction band & holes concentration in valance band (mention of the expression), Electrical conductivity of a semiconductor (derivation), Effect of temperature on conductivity of intrinsic and extrinsic semiconductors, p-n junction, Unbiased and biased pn junction.

Hall effect - theory with derivation for Hall coefficient, carrier concentration, andmobility, applications, Numerical problems.

Dielectrics — **7 Hours**

Dielectrics, Dipoles, Polar and non-polar dielectrics, Dielectric constant, Electric polarization, Polarizability, Electrical Polarization Mechanisms, Electric susceptibility (relation between P, χ and E - no derivation), Internal fields in solids (theory based on one dimensional atomic array), Clausius-Mossotti equation (Derivation), temperature dependence of polarization, Solid, Liquid and Gaseous dielectrics, Frequency dependence of polarization, Dielectric loss, Dielectric breakdown,
Ferroelectric materials and Piezoelectric materials, properties and applications, Numerical Problems.

UNIT-III

Thermoelectric Materials — **05 Hours**

Introduction, Seeback effect, Peltier effect, Seeback and Peltier coefficients, Figure of merit (Mention Expression), Expression for thermo emf in terms of temperature, Thermocouple, Thomson effect, EMF in thermocouple, Thermoelectric power, laws of thermoelectricity, Construction and Working of

Thermoelectric generators (TEG) and Thermoelectric coolers (TEC), Applications of thermocouple, Numerical Problems.

Magnetic Materials	**05 Hours**

Introduction, Terms and definitions, Magnetic permeability, susceptibility, relation between μ_r and χ, Origin of Magnetization - magnetic moment, Bohr magnetron-electron spin, Classification of magnetic materials, Classical theory of magnetic materials (Langevin theory – qualitative), Ferromagnetism, Hysteresis curve, Anti-ferromagnetic materials, Ferrimagnetic materials, soft and hard magnetic materials, Applications of magnetic materials, Numerical problems.

List of Experiments

1.	Spring constant (k) by static and dynamic methods.
2.	Young's modulus by single cantilever method.
3.	Rigidity modulus by torsional pendulum.
4.	Fermi Energy of the given Conductor.
5.	Energy gap of semiconductor by Four Probe Method.
6.	Hall effect
7.	Dielectric constant by charging and discharging of a capacitor.
8.	Study of Peltier effect and See beck effect
9.	Thermo emf - Determination of temperature and sensitivity of thermocouple.
10.	**B-H curve – Study of magnetic hysteresis.**

Course Outcomes: At the end of the course student will be able to

1.	Elucidate and explore the concepts of oscillations and resonance.
2.	Discuss and apply the concepts of Elasticity.
3.	Explain and analyze the properties of semiconductors.
4.	Describe and apply the concepts of dielectrics.
5.	Discuss and analyze the properties of thermoelectric and magnetic materials.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
PH1007-1.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1007-1.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1007-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	J. C. Upadhyaya, "University Physics-I", Himalaya Publishing House, Mumbai.
2	B. G. Streetmann, "Solid State Electronic devices", 6th edition, Prentice Hall India Learning Private Limited.

REFERENCE BOOKS:

1.	A P French, "Vibrations and Waves (MIT introductory Physics Series)", CBS, 2003 Edition.
2.	D. S. Mathur, "Elements of Properties of Matter", S. Chand Publishing.
3.	Timoshenko, S. and Goodier J.N., "Theory of Elasticity", 2nd Edition, McGraw Hill Book Co, 2001.
4.	Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 1997.
5.	Wole Soboyejo, "Mechanical Properties of Engineered Materials", CRC Press, 1st edition, 2002.
6.	Gupta and Kumar, "Solid State Physics", K. Nath & Co., Meerut
7.	W. A. Wahab, "Solid State Physics, Structure and Properties of Materials", Narosa Publishing

	House Pvt. Ltd., New Delhi.
8.	A. J. Dekker, "Electrical Engineering Materials", Prentice Hall India Pub., New Delhi, Reprint 2011.
9.	M. N. Avadhanulu, P G Kshirsagar and TVS Arun Murthy, "A Textbook of Engineering Physics", S. Chand and Company Limited, New Delhi.
10.	M. Ali. Omar, "Elements of Solid State Physics: Principles and Applications", Pearson Publishers.
11.	Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Education Private Limited, Special Indian Edition, 2009.
12.	V. Raghavan, "Materials Science and Engineering", PHI Pub.,
E Books / MOOCs/ NPTEL/ Web links	
1.	Simple Harmonic motion: https://www.youtube.com/watch?v=k2FvSzWeVxQ
2.	Stress-strain curves: https://web.mit.edu/course/3/3.11/www/modules/ss.pdf
3.	Stress curves: https://www.youtube.com/watch?v=f08Y39UiC-o
4.	Oscillations and waves: https://openstax.org › books › college-physics-2e
5.	Thermoelecticity: https://www.youtube.com/watch?v=2w7NBuu5w9c&list=PLtkeUZItwHK5y6qy1GFxa4Z4RcmzUaaz6
6.	Thermoelectric generator and coolers: https://www.youtube.com/watch?v=NruYdb31xk8
7.	Material characterization: https://onlinecourses.nptel.ac.in/noc20_mm14/preview https://www.encyclopedia.com/science-and-technology/physics/physics/cryogenics https://www.usna.edu/NAOE/_files/documents/Courses/EN380/Course_Notes/Ch10_Deformation.pdf
8.	Virtual lab: https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	
1.	http://nptel.ac.in
2.	https://swayam.gov.in
3.	https://virtuallabs.merlot.org/vl_physics.html
4.	https://phet.colorado.edu
5.	https://www.myphysicslab.com

ELEMENTS OF MECHANICAL ENGINEERING

Course Code:	**ME1003-2**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and processes.

1.	Understand the principles of energy sources, formation of steam and boilers.
2.	Know the working principles of pumps, compressors, and turbines.
3.	Understand basic principles of I. C. Engines, Refrigeration and Airconditioning.
4.	Understand the basic principles of power transmission and metal joining processes.
5.	Understand the different machining operations, automation, and robotics.

UNIT-I

09 Hours

Introduction to Mechanical Engineering (Overview only):
Role of Mechanical Engineering in Industries and Society- Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Biomaterials, Biomedical applications, implants, Additive manufacturing.
Simple stress and strain
Introduction, stress, strain, Mechanical properties of materials, Linear elasticity, Hook‟s Law and Poisson's ratio, Stress-Strain relation - behavior in Tension for Mild steel and nonferrous metals. Modes of heat transfer, Laws of Thermodynamics, Steam Formation and its application.
Energy Sources and Power Plants:
Basic working principles of Hydel power plant, Thermal power plant, nuclear power plant, Solar power plant, Tidal power plant and Wind power plant.

06 Hours

Pumps and compressors: Introduction, Working principles of Centrifugal Pump and Single Stage Reciprocating Compressor.
Turbines: Working principles of Impulse and Reaction steam turbines (De Laval and Parson's turbines), Water turbines (Pelton wheel, Kaplan, and Francis turbines), Gas turbines (Open and Closed cycles).

UNIT-II

09 Hours

Introduction to IC Engines: Components and working principles, 4-Stroke Petrol and Diesel engines, Application of IC Engines, performance of IC engines (Simple numericals).
Insight into future mobility technology; Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles. Advantages and disadvantages of Electric Vehicles (EVs) and Hybrid vehicles.
Introduction to Refrigeration and Air Conditioning: Principle of refrigeration, Refrigerants and their desirable properties. Working principle of VCR refrigeration system, working principle of room air conditioner & Applications of air Conditioners.

06 Hours

Mechanical Power Transmission:
Gear Drives: Types - spur, helical, bevel, worm and rack and pinion, velocity ratio, simple and compound gear trains (simple numerical problems)
Belt Drives: Introduction, Types of belt drives (Flat and V-Belt Drive), length of the belt and tensions ratio (simple numerical problems)
Joining Processes: Soldering, Brazing and Welding, Definitions, classification of welding process, Arc welding, Gas welding, (types of flames), TIG welding, MIG welding and Fusion welding.

UNIT-III

10 Hours

Machine Tool Operations:
Lathe: Principle of working of a center lathe, lathe operations: Turning, facing, knurling, thread cutting, taper turning by swivelling the compound rest,

Drilling Machine: Working of simple drilling machine, drilling operations: drilling, boring, reaming, tapping, counter sinking, counter boring,
Milling Machine: Working and types of milling machine, milling operations: plane milling, end milling and slot milling.
(No sketches of machine tools, sketches to be used only for explaining the operations).
Mechatronics and Automation: Meaning, Need for automation, Types - Fixed, Programmable & Flexible automation. Elements of automated systems, Open and Closed loop control systems. Example of a simple pneumatic/ hydraulic/ electro-pneumatic circuit with function of each component.
Robotics: Introduction, Robot Anatomy, Classification based on Robot Configuration, Applications of Robots.

Course Outcomes: At the end of the course student will be able to

1.	Explain the principles of energy sources, formation of steam and Energy sources. And simple stress and strain.
2.	Discuss the working principles of pumps, compressors, and turbines.
3.	Explain basic principles of I. C. Engines, Future mobility and Refrigeration, Air conditioning
4.	Discuss the basic principles of power transmission and metal joining processes.
5.	Explain the different machining operations, automation, and robotics.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1003-2.1	3	1	-	-	-	1	-	1	-	1	-	-	-	-	-
ME1003-2.2	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1003-2.3	3	2	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1003-2.4	3	2	-	-	-	-	-	-	1	1	-	-	-	-	-
ME1003-2.5	3	2	-	-	-	-	-	1	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering" Subhash Publishers, Bangalore, 2010
2.	Mikell P. Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI, 2012
3.	V.K. Manglik, "Elements of Mechanical Engineering", PHI Publications, 2013.

REFERENCE BOOKS

1.	S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 4th Edition 2006, Universities Press (India) Pvt. Ltd, Hyderabad.
2.	K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt Ltd, Mumbai,7th Edition,2012.
3.	Pravin Kumar, "Basic Mechanical Engineering", 2013 Edition, Pearson.

E Books / MOOCs/ NPTEL

1.	https://nidm.gov.in/iec.asp (Study material of National Institute of Disaster management)

ENGINEERING MECHANICS

Course Code:	**CV1003-1**	**Course Type**	**ESC**

Teaching Hours/Week (L: T: P: S)	4:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Develop the analytical skills to solve coplanar concurrent and non-concurrent force system
2.	Understand centroid and moment of inertia of plane areas
3.	Understand free body diagram concept and analyze cylinders, strings, block and ladder using equilibrium conditions.
4.	Identify different types of supports, loadings and analyze determinate beams
5.	Understand bending and shear force variation in determinate beams

UNIT-I

08 Hours

Engineering mechanics: basic idealizations, definition of force, characteristics of a force, classification of force system, principle of transmissibility.
Resultant of coplanar concurrent force system: resolution of a force, composition of forces, resultant and equilibrant, resultant of coplanar concurrent force system.
Resultant of Coplanar non-concurrent force system: Moment of a force, couple, characteristics of couple, Equivalent force - couple system; Varignon's theorem, resultant of coplanar non-concurrent force system.

08 Hours

Centroid: Centroid of plane areas, locating the centroid of rectangular, triangular and circular areas using method of integration, centroid of simple composite areas.
Moment of Inertia: Moment of inertia of an area, polar moment of inertia, radius of gyration, perpendicular axis theorem and parallel axis theorem; moment of inertia of rectangular, triangular, and circular areas from the method of integration; moment of inertia of plane areas.

UNIT-II

08 Hours

Equilibrium of rigid bodies: Definition, conditions of equilibrium for coplanar concurrent force system, concept of free body diagram, equilibrium of cylinders and strings.
Friction: Theory of friction, types of friction, Coulumb’s laws of friction, limiting friction, angle of friction, plane friction and ladder friction.

08 Hours

Support Reactions: Types of beams, loads, and supports, support reactions for statically determinate beams with point load (normal and inclined), uniformly distributed load(UDL), uniformly varying loads(UVL), and moments.

UNIT-III

08 Hours

Shear force and bending moment: Definition, relationship between loading, shear force and bending moment, shear force and bending moment diagrams for statically determinate beams subjected to point loads, UDL, UVL and couple.

Course Outcomes: At the end of the course student will be able to

1.	Solve resultant of coplanar concurrent and non-concurrent force system.
2.	Determine the centroid and moment of inertia of plane areas about the reference axes.
3.	Analyze for unknown forces in the cylinders, strings, block and ladder using equilibrium conditions.
4.	Find the support reactions of determinate beams.

5.	Analyze the determinate beams and draw the variation of bending moment and shear force.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
CV1003-1.1	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CV1003-1.2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CV1003-1.3	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CV1003-1.4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CV1003-1.5	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ferdinand L. Singer, "Engineering Mechanics", Harper and Row Publishers, New York, 3rd edition, 2015.
2. Meriam J. L., Kraige L. G., "Engineering Mechanics: Statistics", 7th Edition, John Wiley & Sons, 2004.

REFERENCE BOOKS:

1. Ferdinand P. Beer and E. Russel Johnson, "Mechanics for Engineers: Statics and dynamics" McGraw-Hill Book Company, New York, 4th edition, 1987.
2. Timoshenko, Young, J. V Rao and S. Patil "Engineering Mechanics", McGraw-Hill Book Company, New Delhi, 5th edition, 2013.
3. Merium J.L, Kraige L.G, "Engineering Mechanics", Vol. I & II, Wiley Publishers,1993.
4. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications (P) Ltd., 2016.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/112/106/112106286/
2. http://nptel.vtu.ac.in/econtent/courses/BS/CIV1323/index.php
3. https://lecturenotes.in/notes/15363-note-for-element-of-civil-engineering-and-mechanics-ecem-by-vtu-rangers

INTRODUCTION TO PYTHON PROGRAMMING

Course Code:	**CS1005-1**	**Course Type:**	**PLC**
Teaching Hours/Week (L: T: P: S):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**26+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Construct python programs using data types and looping.
2.	Make use of python operators for manipulating lists, dictionaries and files.
3.	Design function based Python programs.
4.	Design list, tuple related programs in Python.
5.	Write string handling programs in python.

UNIT-I

Introduction	**10 Hours**

Introduction to Computer generations and types, CPU, Primary Memory, Secondary Memory, Ports and Connections.
Problem solving, Program Development steps, Introduction to Algorithms and Flowcharts.
Introduction to python, basic syntax, interactive shell, editing, saving, and running a script.
The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages;
Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit evaluation

UNIT-II

Data structure and function	**10 Hours**

LISTS, TUPLES, AND DICTIONARIES; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.
FUNCTIONS
Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Recursive functions, Lambda functions.
Introduction to Object oriented concepts – Class, object and member function

UNIT-III

Strings and text files	**06 Hours**

STRING MANIPULATIONS: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers
Manipulating files and directories, text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

Suggested List of Experiments

1.	Experiments related to basic operation, data types and variables.

2.	Experiments related to operations of Lists, tuples and dictionaries.
3.	Experiments on writing functions and parameter passing.
4.	Experiments related to working with strings.
5.	Experiments related to file handling.

Course Outcomes: At the end of the course student will be able to

1.	Experiment with the basics of python programming like data types and looping
2.	Experiment string manipulation operators in programming
3.	Apply the Python operators for manipulating lists, dictionaries and files
4.	Design functions in python for modular programming
5.	Perform operations on string

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
CS1005-1.1	1	2	1	2	-	-	2	-	-	-	-	2	-	1	1
CS1005-1.2	-	2	-	-	-	1	-	-	-	-	-	1	-	2	-
CS1005-1.3	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1
CS1005-1.4	-	1	-	2	-	1	-	-	-	-	-	1	-	-	-
CS1005-1.5	-	-	1	3	-	-	2	-	-	-	1	2	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, 2011.
2.	Magnus Lie Hetland, "Beginning Python from Novice to Professional", Second Edition, Apress, 2009.
3.	Mark Summerfield, "Programming in Python 3 - A Complete Introduction to the Python Language", Second Edition, Addison-Wesley, 2009.
4.	Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 2013.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
CS1002-1.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

IT SKILLS

Course Code:	**CS1002-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:2**	**Credits:**	**02**
Total Teaching Hours:	**13+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Any Departmrnt

Course Objectives:

1.	Demonstrate the basics of Android Programming.
2.	Design and develop effective static web pages.
3.	Describe the basic concepts of Cloud.
4.	Analyse data using Microsoft Excel.
5.	Create interactive gaming applications through Scratch coding.

Suggested List of Experiments

6.	**Design and create simple game using MIT-scratch/Code.org** • Design and create catch game using MIT scratch coding. • Design and create a Jumping game using MIT scratch coding. • Design and create pong game using MIT scratch coding.
7.	**Design and create simple android applications using MIT app inventor.** • Create an application to display a “Hello, World!” message on screen. Application should also display the current time and date. • Implement an application to change the background colour and image of the screen. • Create a simple calculator which can perform basic arithmetic operations like addition, subtraction, multiplication, or division depending upon the user input. • Build a bouncing ball app or make a ball bounce around on the screen (on a Canvas). • Write an application to send SMS using MIT app inventor and also implement a text-to-speech application by passing text from the user.
8.	**HTML and CSS** HTML: Basic Tags - paragraph, headings, Hyperlinks, image, tables, HTML forms.
9.	HTML Lists: Unordered Lists, Ordered Lists and Definition list.
10.	Create a form for a survey on the topic of your choice.Include a variety of answer options, including text fields, dropdowns, radio buttons, checkboxes, and a submit button. Use CSS to improve the look of your form.
11.	Design and create web page for a travel book /recipe book with more than 3 pages, add table to list places /recipes (iframe, hyperlink)
12.	**Create user account and demonstrate use of Google drive, Google docs, Google Form.** • Upload and share any files and folders in google drive using different file permissions. • Creation of google forms for applications such as a registration form, feedback form,quiz etc. • Creation of google docs with citation from websites.
13.	**Data Analysis using Microsoft Excel.** • Basic Excel Formulas: Concatenate(),Len(),Days(), Net workdays(), Count(), Counta(), If(), Iferror(), Find(), Search(),Left(), Right() and Rank(). • Conditional Math: Learn to use SUMIF(), SUMIFS(), AVERAGE(), AVERAGEIF(), AVERAGEIFS(), COUNTIF(), COUNTIFS() to add cells only when certain conditions are met.

- VLOOKUP with Approximate or Exact Match: Learn to use VLOOKUP to find an approximate or exact match and return the corresponding value, work with INDEX, MATCH, and HLOOKUP as alternatives to the VLOOKUP function.
- Conditional Formatting: Apply the different rules to the values of the cell in sheets to carry out the analysis of data.
- Optimizing Data: Sorting, Filtering, Excel PivotTables
- Data Validation: Use Data Validation to ensure that users enter valid data in input cells, o restrict users' ability to enter invalid data in cells by providing them with a drop-down list of valid options.
- Data Visualization in Excel-Charts by generating various types of charts.

Course Outcomes:
At the end of the course student will be able to:
1. Develop Gaming Applications using Scratch Coding.
2. Understand the basics of Android Programming.
3. Design attractive and effective Static Web pages.
4. Analyse the basic concepts of Cloud.
5. Utilize Microsoft Excel to conduct data analysis.

Program Outcomes→ ↓ Course Outcomes													PSO↓	
													1	2
CS1002-1.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1002-1.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Suman M, Chinmaya Dash, R Sreenivas Rao "Digital Fluency", Himalaya Publishing Ho Pvt. Ltd., 2021.
2.	Melwyn Amrithraj, Prem Sagar, Pradeep, "Digital Fluency", Himalaya Publishing House I Ltd., 2021.
3.	R G Saha, Dr. Kantesha S, Niha Asif, "Digital Fluency", Himalaya Publishing House Pvt. L 2021.

REFERENCE BOOKS:

1.	Randy Connolly and Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pear Education India.

E Books / MOOCs/ NPTEL

1.	https://www.sas.com/en_in/insights/analytics/machine-learning.html
2.	https://www.aig.com/IoT
3.	14 Types of Phishing Attacks That IT Administrators Should Watch For (syscloud.com)
4.	6 Common Phishing Attacks and How to Protect Against Them (tripwire.com)
5	Important Applications of Cloud Computing (jigsawacademy.com)

	.		
	6.	Phishing Attack Prevention: How to Identify & Avoid Phishing Scams in 2021 | Digital GuardianIT Security FAQ (udel.edu)	

CONSTITUTION OF INDIA			
Course Code	**HU1002-1**	**Course Type**	**MNC**
Teaching Hours/Week (L: T:P)	**1:0:0**	**Credits**	**00**
Total Teaching Hours	**13+0+0**	**CIE + SEE Marks**	**50+50**
Teaching Department: Humanities			
Course Objectives:			

1.	Inculcate Social and Political consciousness of the Indian Polity.
2.	Understand their Obligations, Responsibilities, Privileges and Rights, Duties, and the Role that they have to play in deciding the Administrative Machinery of the country.
3.	Develop National and Patriotic Spirit.
4.	Understand the nature and character of relations between union and state governments.
5.	Divulge the students about the statutory institutions and policies.

UNIT - I

Evolution of the Indian Constitution	6 Hours

1909 Act, 1919 Act, 1935 Govt of India Act, Constituent Assembly: Composition and Functions, Basic structure of Indian Constitution, Fundamental features of the Indian Constitution, Salient Features of Indian Constitution

UNIT - II

Structure of Government	5 Hours

Union Government: Legislature; Executive-President, Prime Minister, Council of Ministers; Judiciary, Judicial Review, and activism. State Government: Executive: Governor, Chief Minister, Council of Ministers.
Local Government: Panchayat Raj Institutions, Urban Governance

UNIT - III

Statutory Institutions	2 Hours

Elections - Election Commission of India, National Human Rights Commission, National Commission for Women.

Course Outcomes: At the end of the course student will be able to

1.	Analyze the legalities and related issues of drafting, adoption, and enforcement of the Indian Constitution as a fundamental law of the nation and the provisions and privileges of Indian Citizenship
2.	Understand and judiciously use the fundamental rights, fundamental duties and privileges envisaged in the constitution propagating social harmony and equality and respecting the rights and liberties of other people.
3.	Contribute in protecting and preserving the sovereignty and integrity of India and have a compassion to all living creatures, uphold sense of brotherhood ness among all citizens of the nation and promote peace and harmony
4.	Respect the Constitutional Institutions and all noble ideals cherished during Indian struggle for freedom
5.	Develop a Spirit of belongingness to the country.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1002-1.1	-	-	-	-	-	-	-	3	-	-	1	1	-	-
HU1002-1.2	-	-	-	-	-	-	-	2	-	-	1	1	-	-
HU1002-1.3	-	-	2	-	-	-	1	2	-	-	1	1	-	-
HU1002-1.4	-	-		-	-	-	-	1	-	-	-	-	-	-
HU1002-1.5	-	-	1	-	-	-	-	3	-	-	1	1	-	-

1: Low 2: Medium 3: High

Reference Materials:

1. Introduction to the Constitution of India; Dr. Durga Das Basu; Twentieth Edition, LexisNexis Butterworths Wadhwa, Nagpur, Haryana, India, Reprint 2011.
2. Introduction to Constitution of India; M.V. Pylee; Fourth Revised Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.
3. Introduction to Constitution of India; Brij Kishore Sharma; Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

4.	An Introduction to Constitution of India and Professional Ethics; Prof. B R Venkatesh and Merunandan K B; Merugu Publications, Bangalore; Second Edition, 2007.
E Resources	
1.	http://nptel.ac.in/courses/109104032/
2.	https://pothi.com/pothi/book/ebook-ministry-law-and-justice-constitution-india
3.	iasplanner.blogspot.com/2010/11/free-ebook-download-constitution-of.html
4.	www.iasabhiyan.com
5.	Samvidhaan, Documentary by Prasaar Bharathi

Mathematics with MATLAB

Course Code:	**MA1006-1**	**Course Type**	**BSC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE Marks**	**100**
Prerequisite	**MA1001-2 /MA1005-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Understand the use of the basic operators, some built-in functions of MATLAB.
2.	Create and work with arrays
3.	Create and display simple plots
4.	Solve by Symbolic and Numerical computation techniques

List of Experiments

1	Introduction to MATLAB: Basic Operators: Arithmetic, Logical and Relational operators. Elementary math functions such as algebraic, trigonometric, logarithmic, exponential functions, Conditions and Loops.
2	Symbolic Computation, plotting curves, surfaces and vector fields.
3	Computation of (a) eigenvalues and eigenvectors of a square matrix; (b) largest eigenvalue and the corresponding eigenvector of a square matrix; (c) rank of a square matrix
4	Solution of system of linear equations by Gauss elimination method
5	Solution of system of linear equations by Gauss-Seidel method
6	Taylor's/ Maclaurin's series expansion of a function of single variable.
7	Computation of partial derivatives and Jacobians
8	Evaluation of double/triple integrals with constant/variable limits.
9	Computation of angle between (a) radius vector and tangent ; (b) two curves
10	Solution (with solution curve) of first order ordinary differential equation
11	Solution (with solution curve) of second and higher order linear differential equation with constant coefficients
12	Compute the roots of algebraic or transcendental equation using Regula-Falsi and Newton Raphson's Method.

Course Outcomes: At the end of the course student will be able to

1.	Write and compile simple MATLAB codes. Implement basic operators and conditions and loops effectively.
2.	Construct MATLAB programs gradually for the mathematics concept they are studying in theory.

3.	Appreciate the pictorial representation of the mathematics concept.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
EC2602-1.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
EC2602-1.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
EC2602-1.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Rudra Pratap, “MATLAB”, OXFORD University press, 2010
2.	Dorothy C. Attaway Ph.D, A practical introduction to prog. And problem solving , 5th edition

E Resources

1.	https://www.mathworks.com › matlab › matlab_prog
2.	https://www.coursera.org/specializations/mathematics-engineers
3.	https://www.coursera.org/specializations/matlab-programming-engineers-scientists
4.	https://www.coursera.org/learn/matlab

INTERNSHIP-I (Activity Based)

Course Code	**UC1001-1**	**CIE Marks**	100
Teaching Hours/Week (L: T: P: S)	-	**SEE Marks**	-
Total Hours of Pedagogy	80-90 Hours (During I/II semesters)	**Total Marks**	100 (Evaluation in I/II/III Semester and grades earned shall be included in IV Semester grade card)
Credits	**2**	**Exam Hours**	--

Course objective

This course is meant to provide students an opportunity to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the institution; contribution at incubation/ innovation /entrepreneurship cell of the institution; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research projects within the institution and Participation in all the activities of Institute’s Innovation Council.

Activities: Refer Appendix B - 3.4 for details

Course outcomes

1. Experience the working in Inter / Institutional activities
2. Work in teams and communicate efficiently both written and oral.
3. Develop the ability to do work in different activities, which will provide the necessary understanding and contribute to the same and provide a foundation to undergo higher level training in subsequent internships.

. **Course Outcomes Mapping with Program Outcomes & PSO**

. **Program Outcomes→** ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
0.UC2001-1.1	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
1.UC2001-1.2	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
2.UC2001-1.3	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
1: Low 2: Medium 3: High															

****

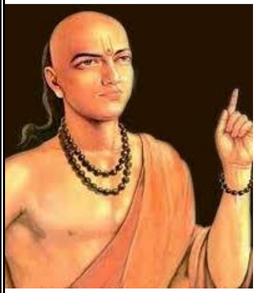
HOLISTIC COMPONENTS

HUMANITIES

Holistic education is not only about teaching the basic subjects, but it is more about redefining the way a student should be taught. The purpose of holistic language teaching is the development of the learners' ability to handle both their language oral skills as well as maximizing their life skills. The department contributes to educational life and work spaces that are creative and meaningful. Multidisciplinary and holistic learning is an ancient method used in Indian education system as well as the other parts of the world. This is the reason that such type of education system was advocated by scholars like Kautilya, Banabhatta, Plato, and Aristotle among many others. Holistic approach is essentially a student centered strategy rather than a teacher centered one.

Holistic education through courses allied to Humanities is created within the inclusive connections of social and human experience. A curriculum built around such stages is considered holistic if they involve the practices that integrates language acquisition and fills multiple cognitive demands in interlocking activities that spiral learning. Through the applied learning style of a person--mind, body and spirit students will learn more effectively the nuances of language, responsibilities towards social fabrics and ethics.

The approach strives to make a learner construct his own understanding of the text he/she interacts with and converses with others according his understanding. Intensive experiential and group sessions, a co-created learning ambience and hands-on engagement through real-life cases, field trips and internships to make learning exciting, rigorous and transformative. As a part of the holistic approach and its philosophy, a student is educated beyond core academics providing him/her virtuous and holistic education. This helps the students to discover their individuality and comprehend the significance of life purposefully, creatively, and morally in a complex world. Krishnamurti writes If the unity of life and the oneness of its purpose could be clearly taught to the young, how much brighter would be our hopes for the future! (Krishnamurti, J. 1974).



MATHEMATICS

INDIAN MATHEMATICIANS

It is essential to know about the ancient, medieval and modern time Indian mathematicians and their contribution to Science and Mathematics. Ancient Indian mathematicians have contributed immensely to the field of mathematics. The invention of zero is attributed to Indians and this contribution outweighs all other made by any other nation since it is the basis of the decimal number system, without which no advancement in mathematics would have been possible. The number system used today was invented by Indians and it is still called Indo-Arabic numerals because Indians invented them and the Arab merchants took them to the western world.
Here we are introducing some of the important Indian mathematicians from ancient times.

Aryabhata: (500 A. D.) - Studied at the University of Nalanda, which was considered as a great centre of learning. Aryabhata was a great Indian mathematician. He gave the value of "π" as 3.1416, claiming for the 1st time, that it was approximation. Aryabhata also dealt with other aspects of mathematics and Astronomical calculations, namely Geometry, Mensuration, Square root, Cube root, Progression and Celestial sphere. He presented a method to solve an intermediate equation of certain type that are important in astronomy and computer science.

Bhaskara : (1100 A. D.) - was a great Mathematician and Astrologer. He was the first Mathematician to declare confidently that any term divided by ZERO is infinity and the sum of any term and infinity is infinity. His concept of "Tatkalikagati", which means instantaneous motion, used by astronomers to determine the motion of the planet accurately brought credit to him. He explained the solutions of quadratic and cubic equations. He stated the Rolle's theorems in analysis, the mean value theorem.

Srinivas Ramanujan was an Indian Mathematician who made significant contributions to mathematical analysis, Number theory and continued fractions. He made many important contributions in the field of mathematics with his wonderful and unique knowledge. That's why his birthday is celebrated as Mathematics Day.

PHYSICS

The ancient world had considered Physical Sciences, Chemical Sciences, Earth Sciences, Biological Sciences, Mathematical Sciences etc. as study of nature, which were all studied under the banner of Philosophy. Even today, the philosophers are studying Metaphysics which connects physical attributes to mind. Physics is a branch of science which deals with the study of matter and energy. The Physical Science was a matter of interest for all the civilizations including Vedic era of India dating back to over 3000 years. The physical science in ancient India was majorly

restricted to Astronomy and Astrology. It was **Kanada**(600 B.C.) who presented holistic approach of physics, by blending science, philosophy and religion through 'Vaisesika Sutra'. Their essence is the atomic theory of matter. He gave the name 'Paramanu' (Atom), to be the indivisible entity of matter. The idea of chemical change was also put forward by Kanada. Bharadwaja is credited with teaching missile technology. Aryabhata(500 A.D.) was a great astronomer. He was the first to state that the earth is round and it rotates on its own axis, creating day and night. He declared that the moon is dark and shines only because of sunlight. Aryabhatta contributed greatly to the field of science particularly astronomy. Varaha mihira (500 A.D.) studied astrology and astronomy and declared that the earth was spherical. He also proposed that the moon and planets are lustrous not because of their own light but due to sunlight. Bhaskra (1100 A. D.) was a great scientist his concept of "Tatkalikagati", which means instantaneous motion, used by astronomers to determine the motion of the planet accurately brought credit to him. Brahmagupta(598 A.D.) calculated the instantaneous motion of a planet, gave correct equations for parallax, and some information related to the computation of eclipses and is widely regarded as one of the most accomplished of the ancient Indian astronomers. "If you wish to make an apple pie from scratch, you must first invent the universe."So said astronomer Carl Sagan in an episode of his landmark television series, Cosmos. Embedded in Sagan's memorable quip is a certain holistic understanding of the universe — a notion that the existence of any one thing is intimately tied to the existence of everything else. There are no apple pies without apples; there are no apples without the proper climate for growing apple trees; there is no proper climate for growing apple trees without a planet on which the apple trees can grow — and so on, all the way back to the Big Bang.Pythagoras and his followers held mathematics in an almost holy regard, and they saw numbers as a basic form of matter. According to their view, all things had numbers, and the objects of the universe — including human societies — were arranged in harmonious mathematical relationships with one another.

All sciences were originated from philosophy. Physics was called natural philosophy until the 19th century, but once it was proven to be correct it was no longer philosophy and became a science. Physics is the science of the natural world, more specifically dealing with the matter, energy, space-time, and fundamental forces that govern the physical world. In physics we study a wide range of physical phenomena from subatomic particles to large galaxies of the material universe, and use empirical data and mathematics to find results and conclusions. Physics is also deeply concerned with arriving at knowledge about the ultimate nature of reality. Since we cannot know whether we have discovered everything which would affect our theories of the universe, all such theories are perpetually subject to modification or change. Mathematics is a language and a tool that we use in physics to explain the universe. Quantum physics is a mathematical description that rules the tiny world of atoms and subatomic particles in our universe. Without quantum physics, much of the information technology that we rely on, from microcircuits to lasers, would not exist. Today many scientists argue that metaphysics plays an important role in quantum mechanics at a deeper level; the nature of reality is all mathematical. This could be an example of how metaphysical assumptions can get in the way of our understanding the paradoxical nature of quantum mechanics. But even when quantum mechanics appears a mystical science of metaphysics, it is not metaphysics but productive science.

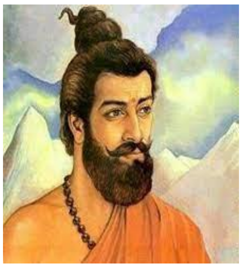
Thus, the Physics though has many branches and uses many other branches of science and philosophy, in the past and the present, its aim is to understand the whole universe which is nothing but matter and energy which is seen or unseen.

CHEMISTRY

ANCIENT SEERS OF INDIA – CHEMISTRY

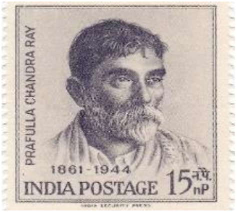
In ancient India, chemistry was called **Rasayan Shastra, Rasa-Vidya, Rasatantra and Rasakriya** all of which roughly mean '***Science of Liquids***'. There also existed chemical laboratories which were called **Rasakriya-nagaram**/**Rasakriya-shala**, which literally mean '***School where liquids are activated***'. Rigveda (earlier than 1500 BCE) mentions many fermented drinks and methods of fermentation, apart from various metals. Soma juice from the stems of the soma plant was considered a divine drink. The Vedic Indians were acquainted with the art of dyeing with certain natural vegetable colouring matters. A type of pottery, now known as 'Painted Grey Ware', is also associated with the Vedic period.

Ancient chemistry in India grew out of the early efforts to develop an elixir; to turn base metals into gold and on metallurgy. Chemical techniques in India can be traced back all the way to the Indus valley or Harappan civilisation (3rd millennium BCE). Pre-Harappan Indians were acquainted with the art of making baked or burnt clay pottery as well as painting the same with two or more colours (by addition of iron oxide, manganese oxide, etc.). Kautilya's Arthashaastra (3rd or 4th century BCE) has a lot of information on prevailing chemical practices. Apart from mines and minerals, it discusses the details of precious stones (pearl, ruby, beryl, etc.); preparation of fermented juices (sugarcane, jaggery, honey, jambu, jackfruit, mango, etc.) and oil extraction.



It is said that **Maharshi Kanada** was the first to propound that the *Parmanu* (atom) was an indestructible particle of matter and that Universe is made up of *Kana*. When matter is divided and sudivided, we reach a stage beyond which no division is possible, the undivisible element of matter is *Parmanu*. Kanada explained that this indivisible, indestructible y cannot be sensed through any human organ.

Nagarjuna (931 A.D.) from Somnath in Gujarat was a chemist/alchemist, who concentrated his efforts in transforming the base metals into gold. His reputation was such that people believed Nagarjuna to be in communion with gods and goddesses who had blessed him with the power of changing base metals into gold and extracting the 'elixir of life'.



Prafulla Chandra Ray (1861-1944), an Indian chemist, is often referred to as the Father of Chemistry in India. He received his BS in 1882 and his PhD in 1887 from University of Edinburgh. In 1896, he announced a major discovery of a new compound, mercurous nitrite. Today's Science and Technology has been greatly inspired by the contributions of these wise seers. Indians have continued to show their global impact in the Field of Science.

In the 21st century, biochemist **Har Gobind Khorana** won the Nobel Prize (1968) for demonstrating how the nucleotides in nucleic acids control the synthesis of proteins.
Thus, the seers of ancient India have contributed significantly in the development of Modern Chemistry.

BIOTECHNOLOGY

Biology for Engineers

Science deals with matter. It is based on starting from scratch with what a human can observe, test, and rationalize. Ancient sages have worked hard to be seen as the only reliable providers of knowledge to the world. In 1875, the Vymaanika Shaastra, a 4th Century BC text written by Sage Bharadwaj was discovered in a temple in India. It contains 3000 shlokas in 8 chapters which was physically delivered by the ancient Hindu Sage Bharadwaj. The book greatly deals with the operation of ancient vimanas and included information on steering, precautions for long flights, protection of the airships from storms and lightning and how to switch the drive of solar energy or some other form of energy. One of the chapter will reveal the secrets of constructing aeroplanes that cannot be broken or cut, that is indestructible, that is fire resistant. It also deals with the secret of making planes motionless and invisible. It also describes how to defeat the enemy planes etc. as per the Sage Bharadwaj the vimanas were classifies as per the Yugas. During the period of Krita Yuga, Dharma was establishes firmly. The pushpak Vimana which was used by Ravan was an Aerial vehicle. He used this vehicle to kidnap Sita from jungle and took him to his Kingdom Srilanka. Ramayana was during the Treta Yug in which the Vimanas were highly discovered. During this period "Laghima" gave them the power to lighten their vehicle do they can travel freely in the air.

COMPUTER, INFORMATION SCIENCE & ENGINEERING

The Indians (**Aryabhata**, 476 BC - 550 BC) contributed **Zero (0)** to the number system**.** So that numeric system and computing world found an ease in solving numerical problems using computer programs.
Acharya **Pingala** was an ancient Indian mathematician who lived around 300 BCE. He wrote the Chandaḥśāstra, where he analysed **Sanskrit poetry mathematically**. It also contained the first known explanations of **digit zero**, **binary numbers, Fibonacci numbers and Pascal's triangle**.
Baudhayana (8th century BCE) composed the Baudhayana Sulba Sutra, which contains examples of Pythagorean triples, such as: (3,4,5), (5,12,13), (8,15,17), (7,24,25) and (12,35,37) as well as a statement of the Pythagorean theorem for the sides of a square: "The rope which is stretched across the diagonal of a square produces an area double the size of the original square."
In Indian astronomy, the study of **trigonometric functions** flourished in the Gupta period, especially due to **Aryabhata (sixth century CE),** who discovered the **sine function**.
Quadratic equation of the form $\mathbf{ax^2 + bx + c = 0, a \neq 0}$ and is given by $x = (-b \pm \sqrt{(b^2 - 4ac)}) / 2a$. was discovered by **Sridharacharya** in the 11th century.

The largest numbers the Greeks and Romans used were 106. In 5000 BC **Indians used numbers as big as 10^{53}** (10 to the power 53) with specific names. The largest used number today is **Tera 10^{12}**.

Kaṭapayadi numerical notation is an ancient Indian system to depict letters to numbers for easy remembrance of numbers as **words or verses**.
For example: क(Ka)=1 ख(Ka)=2 ग(Ga)=3 घ(Ga)=4 ज़(Gnya)=5 च(Cha)=6 छ(Cha)=7 ज(Ja)=8 झ(Ja)=9 अ(Nya)=0. The modern **Hasing technique in computing system** which is resembling was then being used in the **Indian Katapayadi system**. For example, the hashing number based on Katapayadi system would be as follows for '**Gurudev'**
Gu=Ga(is the consonant)=3, Ru=Ra(is the consonant)=2, De=Da(is the consonant)=8 Va=Va(is the consonant)=4, So Gurudeva = 4823.
In the recent decades, following are the few of the major contributors to the computing world:

1. In 1996 the USB port invented by the **Ajay Bhatt,** an Indian at Intel Oregon which involved low level **programs delt with embedded C Language** to perform flexible IO transfer and opened up an area to use plug-and-play devices efficiently.
2. The Pentium chip invented by **Vinod Dham,** that **made C compiler to speed up the program execution** and do well with **GUI applications (both System and User Level) that are wiritten in C language.**
3. **Amit Singhal** is an Indian who rewrote (search engine in 2001) the **google algorithm** (C language coding embedded with Assembly Language service routins in Windows and Unix/Linux). Then on the Google processes over 40,000 search queries every second on average which translates to over **3.5 billion searches per day** and **1.2 trillion searches per year** worldwide.

Few of the contribution as Auther of CP and Educators of C language:

1. **Yashavant Kanetkar** is an Indian computer science author, known for his varieties of C Programming books.
2. **E. Balagurusamy : An Computer scientist** known for **Programming in ANSI C.**

ELECTRONICS AND COMMUNICATION ENGINEERING

The idea of a holistic approach to engineering design and education has been envisioned to meet the perceived and emerging needs for innovation in the 21st century. Many engineering educators, practicing engineers and engineering students have already recognized the gaps and areas of potential improvements in the knowledge acquisition process implemented in current engineering degree programs when compared to current societal and technological issues and developments.

Society and humanity have progressed drastically over the past few generations. Engineers as a network of professional problem solvers have been heavily involved in these global communities and the engineering profession is evolving from one that focuses on targeted, isolated issues, to one that embraces challenges that incorporate physical, economic, environmental, and humanitarian aspects.

Currently, engineering students are required to take classes on ethics, liberal studies and technology and society courses, however engineering students are not prefaced with the importance of rounding out their education with these topics, and while social issues are discussed, they are not related to engineering specifically. That being said, explicitly linking the technical aspects of engineering to society is paramount in training effective problem solvers for the 21st century. With some exposure to multi-disciplinary, inter-disciplinary and trans-disciplinary approaches to engineering and design, students will be better prepared for their future careers in industry or research fields.

The functional requirements for the perceived solution were determined by the expected outcomes and what students should take away after experiencing the new educational product. Some of them are:

• students will be inspired and driven to seek opportunities in engineering for environmental, social, medical, and human development/poverty issues.

• students will be able to identify the issues that are emerging from new technology, how to mitigate the negative aspects and reduce the amount of impact, while leveraging the positive outcomes.

• students will have respect and knowledge of the importance of ethics and policy matters in the field of engineering and be able to determine between unethical and an ethical situation in a proactive manner.

The courses should overcome the challenges of the current engineering educational system. Approaching the degree from a holistic perspective. The integrated system that fosters collaboration among faculty and students. A new organizational and pedagogical model, which emphasizes knowledge integration and interweaves thematic content threads throughout the curriculum should be proposed.

- Foundations thread (math and science) Key mathematical concepts lay the foundation for understanding the anchoring concepts in courses throughout the ECE curriculum. The foundations thread unpacks mathematics and physics concepts to help students learn fundamentals in ECE topics like circuits, signals and systems, and electromagnetics. The foundations thread champion spearheads the collaboration between the math and ECE departments to introduce and promote the value and utility of mathematics in ECE courses, as well as the importance of mathematical thinking.
- Creativity thread (research, design, and optimization tools) The creativity thread is intended to integrate research and design throughout the undergraduate experience. By showing the impact of research, students will see the practical applications and potential breakthroughs of fundamental ECE concepts. Likewise, exposing students to design at every level of the undergraduate experience allows them to experience the excitement of engineering by applying their foundational knowledge to a tangible product.
- Professional formation thread (communications, cultural adaptability, ethics, leadership, and teamwork) Partnering with faculty and industry leaders to ensure students develop professional skills meaningfully and effectively to enhance student-industry interactions.

ELECTRICAL AND ELECTRONICS ENGINEERING

Agastya Samshita available at Prince's Library of Ujjain in India, dates back to the first millennium BC, contains a detailed description construction of an electric battery/cell along with way to utilize the battery to 'split' water into its constituent gasses. The method of generating electricity using modern battery cell resembles Agastya's method. The materials used by Sage Agastya for generating electricity were an earthen pot, copper plate, copper sulphate, wet saw dust, zinc amalgam. As quoted in Agastya Samhita the open circuit voltage and short circuit current of the prepared cell are 1.138 volts and 23 mA respectively. He articulates 100 earthen pots on water, has the power to change the form of water to oxygen and hydrogen. If hydrogen is contained in an air tight cloth, it can be used in aerodynamics, i.e. it will fly in air. In an iron vessel and in a strong acidic medium, gold or silver nitrate covers copper with a layer of gold or silver. The copper that is covered by gold is called Shatakumbha or artificial gold.

Rao Saheb Krishnaji Vajhe, an engineer from Pune while reading books related to science found the pages of Agastya Samhita with Damodar Tryambak Joshi of Ujjain. Dr. M. C. Sahastrabuddhe, the Head of the Sanskrit Department in Nagpur, when reading Agastya Samhita found the similarity of it with of Daniel Cell. He requested P.P. Hole, the Professor of Engineering at Nagpur to investigate on the same.

On the basis of the descriptions in Agastya Samhita Mr. Hole and his friend started preparing the apparatus for the experiment. While preparing the set up they could not understand the meaning of shikhigreeva and while checking the Sanskrit dictionary, they understood that it meant the neck of a peacock. They went to Maharaja Park and asked the chief when a peacock would die. The chief was very angry and asked them to give in an application. After few days during a conversation with an Ayurveda expert he confirmed that shikhigreeva is copper sulphate, which solved their problem. Thus, a cell was formed and it had an open circuit voltage of 1.38 volts and short circuit current of 23 milli amperes. The results of the experimentation were communicated to Dr. M.C. Sahastryabuddhe. It was exhibited fourth general meeting at the Swadeshi Vigyan Sanshodhan Sanstha, Nagpur on August 7, 1990 to the scholars. It was concluded that the description was of an electric cell

On the basis on Agastya Samhita and other scriptures, Rao Saheb Vajhe, who spent his life in rummaging the Indian scientific scriptures, gave different names to electricity. The six ancient terminologies for electricity are:

- Tadit—produced by friction from leather or silk,
- Saudamini—produced by friction from gems or glass,
- Vidyut— from clouds or steam,
- Shatakoti alias Shatakumbhi—produced from a battery of hundreds of cells,
- Hradini—obtained from storage cells,
- Ashani—the one emanating from a magnetic rod.

MECHANICAL ENGINEERING

Mechanical engineering is one of the oldest disciplines of engineering, which requires the knowledge of mathematics, materials, physics and other engineering technologies. It is concerned with materials, processes and machines and requires the concepts of forces, moments, energy, entropy, work etc. The developments that are visible in all spheres of life have connection to mechanical engineering. Engineering has made a significant contribution in the development of civilizations and contribution of mechanical engineering in areas like construction of large scale structures including for irrigation, architecture, military etc. is significant. Difficult problems of the society have been solved using simple concepts of mechanical engineering, say for eg. use of lever principle to move heavy objects. In fact, mechanical engineering made a significant contribution to the first cycle of industrial revolution, i.e., industrial revolution 1.0 during the 18th century. James Watt is often called the 'Father of Mechanical Engineering', as his invention of steam engine led to significant developments during the industrial revolution and beyond. The earliest computers were mechanical devices with electronics.

Significant contributions have been made during the Vedic ages and the first ever mechanical device that was invented was wheel and potter. Surmyam Suiramiva identified metals like Fe, Cu, Ag, Au etc., during the Vedic times. People knew about materials and material processing during those times and identified terminologies for the same in Sanskrit and produced gold and silver coins.

Seers like Tritala, Jalayan, Karaa, Vayurathaa and Vidyutrathaa discovered about aerodynamics during Rig Veda period, much before Wright Brothers discovered about aero planes. Computational Fluid Dynamics (CFD) analysis, which we are talking about today for different analysis, was there in the Vimana Shastra slokas.

Mechanical and manufacturing technology of ancient India ensured processing of natural products and their transformation into goods of trade, commerce and export.

Many scientists have made significant contributions to this domain. Leonardo da Vinci (16th century) studied and designed many mechanical systems that were related to transportation and warfare. In 17th century, Isaac Newton contributed the Laws of Motion used in several applications. Rudolf Diesel (18th century) was a German inventor, who created the first successful diesel engine and today diesel engines play a very important role in the transport and power sector in the world. Carl Frederich Benz (18th century) was a German automotive engineer, who developed the first practical automobile.

Mechanical engineering has evolved over the years and today the advent of computer and IT tools has facilitated better mechanical engineering in terms of design, analysis, and manufacturing. A mechanical engineer needs to work in multiple domains and needs to possess multiple skills like design, redesign, analyze, test, manufacture etc. It has been one of the founding disciplines of engineering and has contributed and will keep contributing to the growth and developments in this physical world.

CIVIL ENGINEERING

Indian civilization was the oldest civilization in the world and has a strong tradition of science and technology. It was the land of sages, seers, scholars, and scientists. Hinduism is a knowledge-based civilization, the Vedic texts should not be ignored dismissed as mythologies or as the work of imagination or just containing some moral stories. The Veda means knowledge and they contain relevant knowledge otherwise these texts would not have survived the millennia years of the historic storm. Let us know some of the great work done in ancient times.

Ancient India not only practised scientific methods of design and construction but also documented them for future generations. Here are some tips given by ancient sages on selection of site and construction

(1) Vishwakarma Vastu Shastra- Vishwakarma explains the first point of construction in the ancient book Vastu Shastra – 'पूर्व भूमिं परिक्ष्येत पश्चात् वास्तु प्रकल्पयेत्', This means that before construction one should test the land. Vishwakarma further says that construction should not be done on the land which is very mountainous or on land with large cracks.

Vastu shastra literally "science of architecture" are texts on the traditional Indian system of architecture. These texts describe principles of design, layout, measurements, ground preparation, space arrangement, and spatial geometry. The designs aim to integrate architecture with nature, the relative functions of various parts of the structure, and ancient beliefs utilising geometric patterns (yantra), symmetry, and directional alignments.

(2) Kashyap Shilpa (Craft) – In this ancient book, Kashyap Rishi has said that the foundation should be dug until water is seen because this way you would ensure that you have reached the rock level and the foundation would be strong.

(3) Bhrigu Samhita – In this scripture saint Bhrigu says that before buying land, one should test it for form, colour, juice, smell and touch. Rishi Bhrigu also explains its methods in his book.

Ancient cities of India found on the basis of archaeological discoveries:

- Rama was the world's first king to build a bridge across the sea. But he did not do it on his own. He sought the help of a great engineer called Nala according to Valmiki Ramayana. Any wise man will seek local knowledge when he ventures into new places. Nala knew the shallow areas across the sea in and around Tamilnadu. American space agency NASA also confirmed that there was a bridge through the satellite pictures. Any wise engineer will use such naturally elevated areas instead of deep waters to build a bridge.
- Bageeratha changed the course of the mighty river Ganges. The vast forest areas of modern Bihar, Uttar Pradesh, and West Bengal were made into fertile lands by his marvelous engineering feat. In those days very few people lived in those jungles. Puranas say that Bageeratha did penance for several thousand years to do this that too 'standing in one foot'. This is a phrase Indians use very often. Even the great Tamil poet Tiruvalluvar uses the simile of Stork that stands in one foot to catch a fish. This is the hidden language to say that he tried for a very long time with focused attention.
- Vedic Saint Agasthya discovered the land route to South India via Vindhyas. The Puranas say that he "subdued the arrogance of the hills", this is hidden language. Till Agastya's this great discovery kings and travellers used only sea routes. Since they knew the secret of monsoon winds they can travel to West Bengal or Maharashtra from Sri Lanka in a few months' time.
- Uparichara Vasu, an ancient king made mountain passes for the benefit of land travellers. He was a Vasu king ruling over the Chedi kingdom. Mahabharata says that he kicked the Kolahal Mountain which was blocking the flow of the Shaktimati River. This is a hidden language to say that he diverted the river for irrigation by cutting the hills.
- In short Bageerathan, Agastya, and Uparichara Vasu are the earliest engineers who built dams across the rivers. But unlike modern engineers, they did not use cement or mortar but they used the hills themselves. To avoid the force they made checks and balances. They use a hidden language saying that Shiva bore the force when Ganga came down from heaven.
- Parasuraman retrieved a lot of lands and gave it to Indians. A Pandya king called Nilam Tharu Vil Nediyon built sea walls to prevent the sea from invading the land.
- Balraman always travelled with an axe to clear the forests and make them cultivable. He was a great agriculturist. When Krishna spent most of his time in politics, his brother Balarama did constructive work.
- The Mohanjodaro, created 3000 years ago, is considered as a wonderful piece of civil engineering. Found in archaeological excavations even the ruins prove that this town was well settled and its buildings and roads – all were

made using symmetry and geometrical measurements. The roads found in this city were straight and were made from east to west and north to south and surprisingly they were at an angle of 90 degrees from each other. Buildings were also constructed in proportion. The intersection of the corners, the heights of the walls was equal. The city had public buildings, gardens, a restaurant, a large public bath as well as residential buildings. There was a provision for bathroom, living room etc in the residential buildings. The public buildings were 11.82m long, 7.01m wide and 2.44m high, and there were two streams of water. The building material and bricks of the walls were coated with a substance on which there was no effect of water. Archaeological research shows that people living here were well-versed in the construction techniques.

- Indus Valley Cities such as Harappa, Mohanjadaro, Lothal, Dholavira, Kalibangan need no new interpretations. The well-laid cities with uniform brick structures, Great Bath, most hygienic drainage systems, grain storage barns, and wells are all already well known to the world.
- Dwarka, also known as Lord Krishna's city, also narrates a similar story. Dr S R Rao discovered Dwarka in the archaeological excavation and found that the ancient city (Dwarka Nagar) was well built and settled. There was a wall around the city. The stones used for the construction of buildings did not erode despite the fact that the city was very close to the sea. Two-storey buildings, roads and water system are also found in the city. Copper, bronze and some alloys with zinc mixed up to 34 percent have also been found during the excavation. The size of columns, windows, etc reveals that they were designed with a complete mathematical precision.
- South Indian Tamil saint Appar always travelled with a pickaxe to clear the bushes from the temple towers. He simply followed Balarama. Great Chola king Karikalan built a dam across river Cauvery in Kal Anai. The Grand Anicut was an engineering wonder of ancient Tamils. It was built around the 1st century AD. Big temples of India, the number of which runs into thousands, stand as monumental proof for the engineering skills of Indians. Mamallapuram and other Pallavacave temples are well-known milestones in Indian architecture.
- The Group of Monuments at Hampi are also recognized as a UNESCO World Heritage Site. The Vittala temple—the stone chariot – is the most iconic symbol of Hampi. The Virupaksha Temple at Hampi was built in the seventh century by the Chalukya rulers.


Virupaksha and Vithala Temple in Hampi

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

Off-Campus Centre, Nitte - 574 110, Karnataka, India

Scheme & Syllabus for

B. Tech. (Mechanical Engineering)

DEPARTMENT OF MECHANICAL ENGINEERING

2023-27

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

Off-Campus Centre, Nitte - 574 110, Karnataka, India

B. Tech. in Mechanical Engineering

<u>CREDIT DISTRIBUTION</u>

No.	Course Category	Credit Range	Suggested Credits
16.	Basic Science Courses (BSC)	18-23	22
17.	Engineering Science Courses (ESC)	10-15	13
18.	Emerging Technology Courses (ETC)	03-05	03
19.	Programming Language Courses (PLC)	03-05	03
20.	Professional Core Courses (PCC)	52 - 58	55
21.	Professional Elective Courses (PEC)	12-18	15
22.	Open Elective Courses (OEC)	6	6
23.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
24.	Ability Enhancement Courses (AEC)	9	9
25.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
26.	Holistic Education Courses (HEC)	2	1
27.	Vocational Education Courses (VEC)	1	1
28.	Project Work (PROJ) (UCC)	10-12	10
29.	Internship (INT) (UCC)	8-12	10
30.	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

Course Numbering Scheme

<table>
<tr><th colspan="2">Branch Code</th><th>Course Level</th><th colspan="3">Course Code</th><th>Separator</th><th>Version</th></tr>
<tr><th>Letter</th><th>Letter</th><th>Number</th><th>Number</th><th>Number</th><th>Number</th><th>-</th><th>Number</th></tr>
<tr><td>Branch Code</td><td colspan="7">ME is 2 Letter code for the Department of Mechanical Engineering</td></tr>
<tr><td>Course Level</td><td colspan="7">Course Level is a 1-digit number that can have a value between 1-6 and indicates the dependency of the course on other courses.
Level-1 courses are basic courses with no Engineering Courses as pre-requisites
Level-2 course(s) have Level-1 course(s) as prerequisites
Level-3 course(s) have Level-2 course(s) as prerequisites
Level-4 course(s) have Level-3 course(s) as prerequisites</td></tr>
<tr><td>Course Code</td><td colspan="7">Course Code is a 3 Digit number that can have a value between 001-999 and indicates the number assigned to a course based on the alphabetical order of Course Name, as per the following rules
001-199 is assigned to Professional Core Courses
001-099 for Integrated Professional Core Courses [4 Credit]
100-199 for Professional Core Theory Courses [3 Credit]

201-499 for Professional Elective Courses
201-299 Electives under Group I
301-399 Electives under Group II
401-499 for future use

501-550 for Open Elective Courses

551 – 599 for Vocational Education Courses

601-650 for Professional Core Lab Courses [1 Credit]

651-699 for Ability Enhancement Courses

701-799 for Courses offered to Honours Program</td></tr>
<tr><td>Separator</td><td colspan="7">"-" is used as a separator between the Course code and the version</td></tr>
<tr><td>Version</td><td colspan="7">Version is a 1-digit number that can have a value between 1-9 and indicates minor revisions of the same course.</td></tr>
</table>

B.Tech.

in

Mechanical Engineering

(Scheme of Teaching and Examinations)

NMAM Institute of Technology, Nitte
An off-Campus Institution of
NITTE (Deemed to be University) MANGALORE
B.Tech. (ME): Scheme of Teaching and Examinations 2023-27
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023 - 24)

First Year Scheme

I /II SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**			**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**					
1	BSC	MA1005 – 1	Matrix Algebra and Differential Equations	MAT	3	0	0	3	50	50	100	3
2	BSC	CY1006-1	Chemistry of Engineering Materials	CHE	3	0	2	3	50	50	100	4
3	ESC	ME1003-2	Elements of Mechanical Engineering	ME	3	0	0	3	50	50	100	3
4	ESC	EE1002-1	Basic Electrical and Electronics Engineering	EE	3	0	0	3	50	50	100	3
5	ETC	ME1008-1	Introduction to Internet of Things (IoT)	ME	3	0	0	3	50	50	100	3
6	AEC	CS1002-1	IT Skills	Any Dept.	1	0	2	3	50	50	100	2
7	ESC	ME1001-1	Engineering Skill Development Practice	ME	0	0	2	2	50	50	100	1
8	AEC	BT1651-1	Biology for Engineers	BT	1	0	0	1	50	50	100	1
9	MNC	CV1002-1	Environmental Studies	CV	1	0	0	1	50	0	50	0
				TOTAL	**18**	**0**	**6**	**22**	**450**	**400**	**850**	**20**

Mandatory Internship-I*

1.	INT	UC1001-1	Internship – I	Mandatory Intra Institutional Internship of duration (80 - 90 Hours) to be completed during I & II Semesters. *The grades will be included in the IV semester grade card (Refer 11.5.2 for details)	100	--	100	2

I/II SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	MA1008 – 1	Calculus and Laplace Transforms	MAT	4	0	0	3	50	50	100	4
2	BSC	PH1007-1	Physics of Materials	PHY	3	0	2	3	50	50	100	4
3	ESC	ME1002-1	Computer Aided Engineering Graphics	ME	2	0	2	3	50	50	100	3
4	ESC	CV1003-1	Engineering Mechanics	CV	3	0	0	3	50	50	100	3
5	PLC	CS1005-1	Introduction to Python Programming	ME	2	0	2	3	50	50	100	3
6	HSMC	HU1001-1	Technical English	HU	1	0	2	3	50	50	100	2
7	MNC	HU1002-1	Constitution of India	HU	1	0	0	1	50	0	50	0
8	BSC	MA1006 - 1	Mathematics with MATLAB	MAT	0	0	2	1	50	0	100	1
				TOTAL	**16**	**0**	**8**	**20**	**400**	**300**	**750**	**20**

(Effective from the academic year 2023 - 24)

III SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2003-1	Vector Calculus & Complex Functions	MA	3	0	0	0	03	50	50	100	3
2.	IPCC	ME1006-1	Manufacturing Processes	ME	3	0	2	0	03	50	50	100	4
3.	IPCC	ME1007-1	Material Science and Engineering	ME	3	0	2	0	03	50	50	100	4
4.	PCC	ME1102-1	Mechanics of Materials	ME	3	0	0	0	03	50	50	100	3
5.	PCC	ME1104-1	Thermal Engineering	ME	3	0	0	√	03	50	50	100	3
6.	PCC	ME2602-1	**Manufacturing & Machine Graphics & Drawings**	ME	0	0	2	0	03	50	50	100	1
7.	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	03	50	50	100	2
8.	MNC	HU1003-1	Kannada (Balake / Samskrithika)	Any Dept.	1	0	0	0	-	50	-	50	0
9.	HEC	HU1005-1	Essence of Indian Culture	Any Dept.	1	0	0	0	-	50	-	50	0
TOTAL					**19**	**0**	**6**	**-**	**21**	**450**	**350**	**800**	**20**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	MNC	MA1011 - 1	Bridge Course – Calculus and Laplace Transforms	MA	3	0	0	0	3	100	0	100	0

IV SEMESTER

	Course and	Course Title	Tea	Teaching Hours/Week	Examination	Cr

Sl. No.	Course code				Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2014-1	Probability Theory & Computational Mathematics	MA	3	0	0	0	03	50	50	100	3
2.	IPCC	ME2003-1	**Technology and processes in Heavy Manufacturing**	ME	3	0	2	0	03	50	50	100	4
3.	IPCC	ME1005-1	Fluid Mechanics & Machinery	ME	3	0	2	0	03	50	50	100	4
4.	PCC	ME1103-1	Theory of Machines	ME	3	0	0	0	03	50	50	100	3
5.	PCC	ME1101-1	Engineering Metrology	ME	3	0	0	√	03	50	50	100	3
6.	PCC (Lab)	ME2605-1	Metrology & Measurements Lab (Lab course)	ME	0	0	2	0	03	50	50	100	1
7.	HSMC	HU1004-1	Universal Human Values	Any Dept.	1	0	0	0	01	50	50	100	1
8.	AEC	ME1654-1	Innovations and Design Thinking	ME	1	0	0	0	01	50	50	100	1
9.	VEC	ME1551-1	Department specific Vocational Education Course (PRACTICAL WELDING TECHNOLOGY)	ME	0	0	2	0	03	50	50	100	1
10.	UCC	UC1001-1	Internship – I (Activity based Internship)		Mandatory Intra Institutional Activity based Internship of 2 weeks duration (80 - 90 h) to be completed during the vacations of I & II Semesters. Lateral entry students have to complete the Internship - I during the vacation of III semester					100	-	100	2
TOTAL					**17**	**0**	**8**	**-**	**23**	**550**	**450**	**1000**	**23**
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
11	MNC	MA1013-1	Bridge Course – Probability and Differential Equations	MA	3	0	0	0	3	100	0	100	0

(Effective from the academic year 2023 - 24)

V SEMESTER														
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1.	IPCC	ME2001-1	Automotive Engineering	ME	3	0	2	0	3	50	50	100	4
2.	IPCC	ME3001-1	Finite Element Methods	ME	3	0	2	0	3	50	50	100	4
3.	PCC	ME2104-1	**Mechatronics System in Manufacturing**	ME	3	0	0	0	3	50	50	100	3
4.	PCC (Lab)	ME2604-1	Energy Conversion Lab	ME	0	0	2	0	3	50	50	100	1
5.	PEC	MEXXXX-1	Professional Elective-I [Group-1] **Digital Technologies including CPS,IIOT &Cloud in Manufacturing**	ME	3	0	0	0	3	50	50	100	3
6.	HSMC	HU1006-1	Introduction to IPR	Any Dept.	1	0	0	0	1	50	50	100	1
7.	AEC	MEx6xx-1	Program Specific Ability Enhancement Course	ME	1	0	2	0	3	50	50	100	2
		HU1010-1	Research Methodology	Any Dept.	2	0	0	0					
8.	AEC	HU1007-1	Social Connect & Responsibility	Any Dept.	1	0	0	0	1	50	50	100	1
9.	AEC	UM1003-1	Employability Skill Development	ME	1	0	0	0	-	50	-	50	1
TOTAL					**16/17**	**0**	**8/6**	**-**	**20**	**450**	**400**	**850**	**20**

VI SEMESTER						
	Course and	**Course Title**	**T e a**	**Teaching Hours/Week**	**Examination**	**C r**

Sl. No.	Course code				Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	ME3002-1	Heat Transfer	ME	3	0	2	0	3	50	50	100	4
2.	PCC	ME3100-1	Design of Machine Elements	ME	3	0	0	0	3	50	50	100	3
3.	PCC (Lab)	ME2601-1	CNC Lab	ME	0	0	2	0	3	50	50	100	1
4.	PEC	MEXXXX-1	Professional Elective - II [Group-1]	ME	3	0	0	0	3	50	50	100	3
5.	PEC	MEXXXX-1	Professional Elective -III [Group-2] **Additive Manufacturing**	ME	3	0	0	0	3	50	50	100	3
6.	OEC	XXX5XX-1	Open Elective –I	Any Dept.	3	0	0	0	3	50	50	100	3
7.	HSMC	MG1006-1	**Project management for Professionals**	Any Dept.	3	0	0	0	3	50	50	100	3
8.	AEC	HU1008-1	Life Skills For Engineers	Any Dept.	1	0	0	0	1	50	50	100	1
TOTAL					**19**	**0**	**4**	**-**	**22**	**400**	**400**	**800**	**21**

*** A MNC on Entrepreneurship will be offered with one hour per week with only CIE component.**

NMAM Institute of Technology, Nitte

An off-Campus Institution of
NITTE (Deemed to be University) MANGALORE
B.Tech. (ME): Scheme of Teaching and Examinations 2023-27
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023 - 24)

VII SEMESTER						
	Course and	Course Title	Tea	Teaching Hours/Week	Examination	Cr

Sl. No.	Course code				Theory Lecture L	Tutorial T	Practical/ Drawing P	PBL J	Duration in hr	CIE Marks	SEE Marks	Total Marks	
1.	IPCC	ME2002-1	**Collaborative Robotics in Manufacturing Aided by AI, ML & IIOT**	ME	3	0	2	0	3	50	50	100	4
2.	PCC (Lab)	ME2603-1	Dynamics Lab	ME	0	0	2	0	3	50	50	100	1
3.	PEC	MEXXXX-1	Professional Elective – IV [Group-1]	ME	3	0	0	0	3	50	50	100	3
4.	PEC	MEXXXX-1	Professional Elective – V [Group-2]	ME	3	0	0	0	3	50	50	100	3
5.	OEC	XXX5XX-1	Open Elective –II	Any Dept.	3	0	0	0	3	50	50	100	3
6.	HSMC	MG1009-1	Engineering Economics & Financial Management	ME	3	0	0	0	3	50	50	100	3
7.	HEC	HU1009-1	Indian Knowledge Systems	Any Dept.	1	0	0	0	-	50	-	50	1
8.	UCC	UC3001-1	Major Project Phase I	ME	-	-	4	-	-	100	-	100	2
TOTAL					**16**	**0**	**8**	**-**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week: Theory Lecture L	Tutorial T	Practical/ Drawing P	PBL J	Examination: Duration in hr	CIE Marks	SEE Marks	Total Marks	Credits
1.	UCC	UC2001-1	Internship- II		Mandatory Societal internship for 2 weeks (80 – 90 h) and Research				3	50	50	100	8

			(Societal internship and Research/Industry Internship)		Internship / Industry Internship of 6 weeks (240 – 270 h) or Research Internship / Industry internship for a total of 8 weeks (320 – 360 h)to be completed in one/two stretches during the vacation periods between IV to VII semesters								
2.	UCC	UC3002-1	Major Project Phase II		Student should carry out project in research institute/industry/intra institute Canter of Excellences. Two contact hours /week for interaction between the project guide and students.				3	100	100	200	8
TOTAL					**-**	**-**	**-**	**-**	**6**	**150**	**150**	**300**	**16**

Program Specific Ability Enhancement Courses [AEC]	
Course Code	**Course Title**
ME1651-1	Data Acquisition and Measurements
ME1652-1	Data Processing and Plotting
ME1653-1	Fundamentals of Mechatronics System
ME1654-1	Innovation and Design Thinking
ME1655-1	Introduction to AI and ML
ME1658-1	Principles of Welding
HU1109-1	Research Methodology
ME1660-1	Start-up Policy and General Compliances
ME1661-1	Technical Report writing and Presentation
ME2651-1	Automotive Electronics
ME2652-1	Business Analytics with Python I – Predictive Analytics
ME2653-1	CNC Programming and Machining
ME2654-1	Introduction to Design & fabrication of Unmanned Aerial Vehicles
ME2655-1	Non-Destructive Inspection
ME2656-1	Welding Automation

Open Electives offered to other branch students by the Department [OEC]	
Course Code	**Course Title**
ME1501-1	Automotive Engineering (for all except mechanical)
ME1502-1	Industrial Pollution Control (for all except mechanical)
ME1503-1	Sustainable Development Goals
ME1504-1	Technological Innovation

List of Professional Elective Courses [PEC]			
Group-1		**Group-2**	
DESIGN			
Code	**Elective Course Title**	**Code**	**Elective Course Title**
ME1201-1	Introduction to Piping Engineering	ME1301-1	Introduction to Aircraft Design
ME2201-1	Design of Aircraft Structures	ME2301-1	Advanced strength of materials
ME2202-1	Material selection for Engineering Design	ME2302-1	Control Engineering
ME2203-1	Mechanical Vibrations	ME2303-1	Design of Experiments
ME3201-1	Industrial Tribology		
INFORMATION TECHNOLOGY			
Code	**Elective Course Title**	**Code**	**Elective Course Title**
ME1211-1	Data Structures	ME1311-1	Cloud Computing
ME1212-1	Introduction to Cognitive Computing	ME1312-1	Introduction to Machine Learning
MANAGEMENT			
Code	**Elective Course Title**	**Code**	**Elective Course Title**
ME1221-1	Maintenance & Reliability Engineering	ME1321-1	Financial management
ME1222-1	Marketing Management	ME1322-1	Management Information System
ME1223-1	Operations Management	ME1323-1	Operations Research
ME1224-1	Total Quality Management	ME1324-1	Organizational Behaviour
		ME1325-1	Supply Chain and Logistic Management
MANUFACTURING & AUTOMATION			
Code	**Elective Course Title**	**Code**	**Elective Course Title**
ME2231-1	Computer Integrated Manufacturing	ME2331-1	Additive Manufacturing
ME2232-1	Welding Technology	ME2332-1	Composite Materials Technology
ME2233-1	CAD / CAM	ME2333-1	Foundry Technology
ME2234-1	Fluid Power Systems	ME2334-1	Non Destructive Testing
ME3231-1	Automation in Manufacturing	ME2335-1	Non Traditional Machining
ME3232-1	Surface Engineering	ME2336-1	Micro electromechanical Systems
ME2235-1	Digital Technologies including CPS,IIOT &Cloud in Manufacturing		
THERMAL			
Code	**Elective Course Title**	**Code**	**Elective Course Title**
ME1241-1	Energy Management	ME1341-1	Renewable Sources of Energy
ME2241-1	Wind & Solar Power Engineering	ME2341-1	Gas Propulsion and Aerodynamics
ME2242-1	Power Plant Engineering	ME2342-1	Internal Combustion Engines
ME3241--1	Computational Fluid Dynamics	ME2343-1	Turbo Machines

Courses from Basic Science

VECTOR CALCULUS & COMPLEX FUNCTIONS

Course Code:	**MA2003-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**MA1005-1**		

Teaching Department: Mathematics

Course Objectives:

1.	To apply operators like gradient, divergence and curl to both scalar as well as vector functions.
2.	To evaluate surface and volume integrals in terms of line integrals using various integral theorems.
3.	Determine analyticity of a function and find the derivative of a function. Evaluate an integral using Cauchy's integral formula.
4.	Compute the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line.
5.	Find Fourier series of a function, obtain the half range series and harmonics. Find the Fourier transform and inverse Fourier transform of a function.

UNIT-I

Vector Calculus — **15 Hours**

Vector algebra (review), vector differentiation-gradient, directional derivatives, divergence, curl, Laplacian, solenoidal and irrotational vectors. Curvilinear, spherical and cylindrical co-ordinates.
Vector integration: Line, surface & volume integrals. Green’s theorem, Gauss divergence theorem, Stoke’s theorem and applications.

UNIT-II

Theory of Complex Variables — **15 Hours**

Functions of complex variables, Cauchy Riemann equations, properties of analytic functions, conformal mapping, bilinear transformations.
Line integrals in complex plane, Cauchy’s theorem, Cauchy’s integral formula. Power series-Taylor’s and Laurent’s series. Residues, Cauchy’s residue theorem. Evaluation of standard real integrals using contour integration.

UNIT-III

Fourier Series and Fourier Transforms — **10 Hours**

Periodic functions, Euler’s formulae, Fourier series of odd and even functions, functions with arbitrary period, half range series, harmonic analysis. Fourier integral theorem, Fourier transforms, inverse Fourier transform, convolution theorem and Parseval’s identity. Fourier sine and Fourier cosine transforms, inverse Fourier sine and inverse Fourier cosine transforms.

Course Outcomes: At the end of the course student will be able to

1.	Solve the vector functions and their derivatives for engineering applications.
2.	Demonstrate the applications of Gauss divergence and Stoke’s theorem.
3.	Recognize analytic functions, differentiate and integrate complex functions.
4.	Compute the residue of a function and use the residue theorem to evaluate a contour integral over the real line.
5.	Understand and appreciate the concepts of Fourier series. Find the Fourier transform and the inverse Fourier transform of a function and will be able to apply these concepts in his technical subjects.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 2
MA2003-1.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2003-1.2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2003-1.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2003-1.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2003-1.5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition.
2. Kreysizg, "Advanced Engineering Mathematics", John Wiley and Sons, 6th Edition.

REFERENCE BOOKS:

1. Wylie Ray, "Advanced Engineering Mathematics", 6th edition, McGraw Hill.Inc.
2. Murray R. Spiegal, "Vector Analysis", Schuam Publishing Co.

PROBABILITY THEORY & COMPUTATIONAL MATHEMATICS

Course Code:	**MA2014-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisites	**MA1005-1, MA1008-1, MA2003-1**		

Teaching Department: Mathematics

Course Objectives:

1. Understand the concept of probabilistic models for situation involving chance effect.
2. Study different types of probability distributions.
3. Apply interpolation technique in real life problems
4. Apply numerical differentiation and integration methods, where the function is a complicated expression or given in terms of tabular values or not possible to evaluate by analytical method

5.	Know about the numerical methods to solve ordinary differential equations. Identify and formulate parabolic, hyperbolic and elliptic partial differential equations and solve by grid analysis.

UNIT-I

Probability Theory — **15 Hours**

Finite sample space, probability, conditional probability and independence, Bayes' theorem (overview). One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, expectation and variance. Two Distributions: Binomial, Poisson, Normal and exponential distributions.

UNIT-II

Finite Differences and Interpolation — **15 Hours**

Finite differences: forward, backward and central difference operators, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula, Lagrange's Inverse interpolation formula. Newton's divided difference interpolation formula.
Numerical Differentiation: Numerical differentiation using Newton's forward & backward formulae.
Numerical integration: General quadrature formula, Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule.

UNIT-III

Numerical Methods — **10 Hours**

Solution of algebraic and transcendental equations: Bisection method, Iteration method, Regula falsi Method and Newton Raphson Method.
Numerical solution of ordinary differential equations: Taylor's series method, modified Euler's method and 4^{th} order Runge –Kutta method, Predictor-Corrector methods
Numerical solution of partial differential equations: Solution of Laplace and Poisson equations by standard five point formulae, solution of heat and wave equations

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate and appreciate probabilistic models for situations involving chance effect.
2.	Illustrate the applications different types of distributions for engineering problems.
3.	Using finite differences and interpolation technique in solving real life problems
4.	Understand the numerical differentiation and integration methods and be able to apply these methods to solve engineering problems
5.	Apply numerical methods to solve partial differential equations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
MA2014-1.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2014-1.2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2014-1.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2014-1.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2014-1.5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition.
2. P. L. Meyer, "Introduction of probability and Statistical applications", Second Edition, American Publishing Co. , 1975.

REFERENCE BOOKS:	
1.	Kreysizg, “Advanced Engineering Mathematics”, John Wiley and Sons, 6th Edition.
2.	S. S. Sastry, “Introductory methods of Numerical Analysis”, 2nd Edition, Prentice Hall, 1990.
3.	Wylie Ray, “Advanced Engineering Mathematics”, 6th Edition, McGraw Hill.Inc

Bridge Courses for Lateral Entry Students

BRIDGE COURSE - CALCULUS AND LAPLACE TRANSFORMS

Course Code:	**MA1011-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**00**
Total Teaching Hours:	**40+0+0+0**	**CIE + SEE Marks:**	**100+0**

Teaching Department: Mathematics

This course is prescribed to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, they shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student must fulfill the requirements during subsequent semester/s to appear for CIE.
MNC Courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree

Course Objectives:

1.	This course will enable the students to master the basic tools of differential calculus, partial differentiation, Laplace Transforms and Integration and become skilled for solving problems in science and engineering.

UNIT-I

Differential Calculus	**8 Hours**

Limit, continuity, differentiation rules-product rule, quotient rule and chain rule. Taylor's series, Maclaurin's series of simple functions in single variable.

Partial Differentiation	**7 Hours**

Definition, simple problems to find partial differentials, total differentiation, differentiation of composite functions, illustrative examples, and problems. Taylor's and Maclaurin's series for a function of 2 variables

UNIT-II

Laplace Transforms	**7 Hours**

Definitions, transforms of elementary functions, transforms of derivatives and integrals- properties.

Inverse Laplace Transform	**8 Hours**

Inverse Laplace transforms and properties. Solutions of ordinary differential equations. Applications to engineering problems.

UNIT-III

Integral Calculus-I	**5 Hours**

Introduction, rules of integration, solution of integrals using the methods-substitution and partial fraction, integrals of standard functions, definite integral, simple problems.

Integral Calculus-II	**5 Hours**

Double integrals, change of order of integration, change in to polar coordinates. Triple integrals, simple Problems and applications

Course Outcomes: At the end of the course student will be able to

1.	Learn the concept of limit, continuity, differentiability, and Taylor's theorem.
2.	Learn the concept of partial differentiation of a function with two or more independent variables.
3.	Apply the concept of Laplace transform in engineering applications.
4.	Find the inverse Laplace transform and hence to solve differential equations
5.	Apply the notion of multiple integrals to find areas and volumes.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO**		
↓ Course Outcomes													1	2	3

MA1011-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MA1011-1.2	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MA1011-1.3	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MA1011-1.4	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MA1011-1.5	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1: Low 2: Medium 3: High

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 100% (No Semester End Exam (SEE)) The student must obtain minimum of 40% in CIE to pass.

Continuous Internal Evaluation:

1. Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2. The class teacher must decide the topic for closed book test and Written Quiz. The methods of CIE for the subject must be announced at the beginning of the course.

TEXTBOOKS:

1.	B.S. Grewal, "Higher Engineering Mathematics", 43^{rd} Edition, Khanna Publications, 2015.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10^{th} Edition, John Wiley and Sons, 2016.

REFERENCE BOOKS:

1.	G.B. Thomas and R. L. Finney, "Calculus and Analytic geometry", Pearson, 2002.
2.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
3.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi, 2010

BRIDGE COURSE - PROBABILITY AND DIFFERENTIAL EQUATIONS

Course Code:	**MA1013-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**00**
Total Teaching Hours:	**40+0+0+0**	**CIE + SEE Marks:**	**100+0**

Teaching Department: Mathematics

Mandatory Non – credit course (MNC): This course is prescribed to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, they shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE.

Course Objectives:

1.	This course will enable the students to master the basic tools of matrix theory, probability, differential equations, partial differential equations and become skilled for solving problems in science and engineering.

UNIT-I

Matrices	**8 Hours**
Elementary operations of a matrix, echelon form of a matrix, Rank of a matrix (both definitions). Consistency and solution of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of matrices.	
Probability	**7 Hours**
Finite sample space, event, mutually exclusive event, equally likely event, probability, addition theorem, conditional probability and independence conditions, multiplication theorem. Bayes' theorem.	

UNIT-II

Differential Equations	**8 Hours**
Introduction, order and degree of differential equations, examples. Solution of first order and first-degree differential equations–variable separable method, Linear, Bernoulli's and exact differential equations (without I. F).	
Second And Higher Order LDE	**7 Hours**
Second order linear differential equation with constant coefficients, solution by inverse differential operator and method of variation of parameters.	

UNIT-III

First and Higher Order Partial Differential Equations	**10 Hours**
First and higher order partial differential equations. Formation of partial differential equations by elimination of arbitrary constants/ arbitrary functions. Solution of PDE's by direct integration method.	

Course Outcomes: At the end of the course student will be able to

1.	Reduce the matrix to echelon form and find its rank
2.	Understand the concept of probability and apply Bayes theorem to real life problems
3.	Solve the differential equations
4.	Solve higher order linear differential equations
5.	Form partial differential equations by eliminating the arbitrary constants and functions

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO**		
↓ Course Outcomes													1	2	3
MA1013-1.1	**3**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.2	**3**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.4	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.5	**3**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 100% (No semester end exam). The student must obtain minimum of 40% marks individually in CIE to pass.

Continuous Internal Evaluation:

1. Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2. The class teacher must decide the topics for closed book test and Written Quiz The methods of CIE for the subject must be announced at the beginning of the course.

TEXTBOOKS:

1.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10^{th} Edition (Reprint), John Wiley and Sons, 2016.
2.	B. S. Grewal, "Higher Engineering Mathematics", 43^{rd} Edition, Khanna Publications, 2015.
3.	P. L. Meyer, "Introduction of Probability and Statistical Applications", 2nd Edition, American Publishing, 1975.

REFERENCE BOOKS:

1.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.

2.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi, 2010
3.	N. P. Bali and M. Goyal, "A textbook of Engineering Mathematics", Laxmi Publications, 2010.

Integrated Professional Core Courses

Fluid Mechanics and Machinery

Course Code:	**ME1005-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Have knowledge of fundamentals of fluid mechanics and various laws. Understand and derive Eulers and Bernoulli's equation for fluid flow. Analyse various types of fluid flow measuring equipment.
2.	Get the idea of energy transfer in power generating and power absorbing turbo machines. Understand the features and working of impulse and reaction turbines (Pelton, Francis and Kaplan turbines)
3.	Understand and analyse the working principle of steam (Impulse and reaction) turbines. Understand the principle of operation of centrifugal pumps; also study the parameters affecting their performance

UNIT-I

Properties of fluid:	**07 Hours**

Introductory concepts and definitions, properties of fluids and its classification.
Fluid Statics: Pascal's law of pressure, pressure variation in static fluid, Simple Manometers.Fluid Dynamics General energy and momentum equation. Euler's equation, Bernoulli's equation for real fluids.

Fluid flow measurements:	**08 Hours**

Content: Venturimeter, Orificemeter, pitot tube, V and rectangular notch, Flow through pipes: frictional losses in pipe flow, Darcy- Weisbach equation, Chezy's equation for loss of head due to friction in pipes, Hydraulic gradient line and total energy line.

UNIT-II

Introduction, Energy transfer in Turbo function:	**06 Hours**

Content: Definition of a turbo machine. Parts, Classification, Comparison with positive displacement machine.

Euler Turbine equation:	**05 Hours**

Content : Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, degree of reaction, Utilization factor, relationship between utilization factor and degree of reaction

Hydraulic turbines:	**04 Hours**

Content: Classification, Pelton turbine components, design, turbine efficiency, Francis and Kaplan turbines.

UNIT-III

Steam and gas turbines	**05 Hours**

Content: Impulse staging, need for compounding, types of compounding, condition for maximum utilization for multistage turbines, effect of blade and nozzle losses.

Centrifugal pumps:	**05 Hours**

Content: Working principle, Terminology, Types of casing, Pump losses, Efficiencies, Work done, Pre-rotation, slip and slip coefficient, Minimum starting speed, Priming, Cavitation, NPSH. Multistage centrifugal pumps.

Suggested List of Experiments	
1.	Determination of coefficient of friction of flow in a pipe.
2.	Determination of minor losses in flow through pipes.
3.	Determination of force developed by impact of jets on vanes. Calibration of flow measuring devices a) Orifice plate b) Venturimeter c) Notches
4.	Performance testing of Turbines a) Pelton wheel b) Kaplan Turbine
5.	Performance testing of Pumps a) Single stage centrifugal pumps b) Reciprocating pump
6.	Performance test of a two stage Reciprocating Air Compressors

Course Outcomes: At the end of the course student will be able to

1.	Apply hydrostatic law and Pascal law to solve simple fluid mechanics problems. Apply Bernoulli equation for ideal and real fluids and calculate the components of energy.
2	Analyze fluid flow measuring equipment using the knowledge of Bernoulli equation. Determine coefficient of friction and coefficient of discharge through experiments on flow through pipes.
3	Describe working principles of power absorbing and power generating turbomachines, differentiating them from positive displacement machines. Calculate degree of reaction, utilization factor and energy transfer by plotting relevant velocity diagrams
4	Explain the features and working of impulse and reaction turbines (Pelton, Francis and Kaplan turbines) and to analyze their performance related to design, power generation and efficiency. Experimentally determine coefficient of impact of jet on vanes. Calculate the efficiencies of turbines and draw their characteristics curves.
5	Describe the working principle of steam (Impulse and reaction) turbines and analyze their performance related to design, energy transfer and efficiency. Explain the principle of operation of centrifugal pumps. Analyze parameters affecting their performance. Conduct experiments and calculate the efficiencies of a cetrifugal pump and draw their characteristics curves.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1005-1.1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**
ME1005-1.2	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**2**	**-**
ME1005-1.3	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**
ME1005-1.4	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**-**
ME1005-1.5	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Fluid Mechanics by Yunus A Cengel, John M, Tata Mc Graw Hill, 2013
2.	Fluid Mechanics by Dr. R K Bansal, Laxmi publications, 2005

3.	An Introduction to energy conversion,,, Volume III-Turbo Machinery, V. Kadambi and Manohar Prasad, Wiley Eastern Ltd. 1977
4	"A Treatise on Turbo machines", G. Gopalakrishnan, & D. Prithviraj, Scitech Publications (India) Pvt. Limited.,2002
E Books / MOOCs/ NPTEL	
1.	https://fmc-nitk.vlabs.ac.in/List%20of%20experiments.html
2.	http://vlabs.iitb.ac.in/vlabsdev/labs/mit_bootcamp/fluid_mechanic_13082019/labs/index.php

Manufacturing Processes

Course Code:	**ME1006-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the various manufacturing processes and their selection and familiarize with various special casting techniques available for manufacturing different types of products.
2.	Understand the principle of various hot and cold metal working techniques and processing of ceramics and plastics
3.	Understand the principle, need and applications of various material joining techniques.
4.	To prepare different types of moulds with the help of wooden patterns.
5.	To estimate the raw materials requirement and to create simple smithy models and to prepare various welding joints using arc welding process

UNIT-I

Introduction	**08 Hours**

Classification of engineering materials and processing techniques. Concept of Manufacturing process, its importance. Classification of Manufacturing processes.
Introduction to Casting process: Steps involved. Patterns: Definition, classification, function, and materials used, pattern allowances. Sand Moulding: Types of base sand, requirement of base sand, desirable properties. Binders and Additives: Their uses. Additives: Need, Types of additives used and their properties. Cores: Definition and Need. Fettling and cleaning of castings. Moulding Machines: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

Special moulding Process	**08 Hours**

Content: No bake moulds, Flaskless moulds, Sweep mould, CO2 mould, Shell mould, Investment mould. Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Evaporative pattern casting, Continuous Casting Processes. Introduction to Melting furnaces. Casting defects: Causes and remedies, Introduction to 3-D printing.
Self-Learning: Types of Binders and Additives, their properties, Types of Cores

UNIT-II

Metal Shaping and Forming	**06 Hours**

Content: Hot and cold working: Introduction & comparison. Rolling, Principle and operations. Forging operations, Extrusion. Cold working processes: Shearing, Drawing, Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, dies used for various processes. Powder metallurgy.		
Processing of non-metals		**05 Hours**
Content: Processing of glass: glass melting and forming, glass annealing. Processing of ceramics: ceramic powder preparation, fabrication of ceramic products from powders: pressing, casting, jiggering, sintering.		
Processing of plastics		**04 Hours**
Content: Mechanical properties of plastics, thermoplastics and thermosets, Fabrication: Extrusion. Injection moulding. Thermoforming. Compression moulding. Blow moulding. Self-Learning: Wire and Tube drawing processes.		
UNIT-III		
Welding process		**05 Hours**
Content: Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW).		
Gas Welding:		**04 Hours**
Content: Principle, Oxy – Acetylene welding. Resistance welding – principles. Friction welding, Explosive welding, Thermit welding. Plastic welding. Principles of soldering & brazing. Adhesive bonding. Self-Learning: Laser Welding, Electron Welding, Welding Defects		
Suggested List of Experiments		
15	Study and practice of: Use of foundry tools and other equipment's.	
16	Preparation of moulds using two molding boxes using: Patterns (Split pattern, Match plate pattern and Core boxes).	
17	Preparation of moulds using: Two molding boxes without patterns	
18	Preparation of minimum forged models involving: Drawing down and bending operations.(Simple models like L-nail, and EYE-nail).	
19	Fabricate Lap Joint, Butt Joint, L-Joint, and T-Joint using arc welding technique	

Course Outcomes: At the end of the course student will be able to

1.	Compare conventional manufacturing processes and choose a suitable manufacturing process for making a specified product, and explain the principle of sand casting process. Apply the knowledge of mold preparation, and sand properties to prepare a mold for a given pattern using sand mold making tools.
2.	Explain special casting techniques used in industries and select a suitable casting technique for making a specified product.
3.	Explain the principles of rolling, forging, extrusion and sheet metal working and choose a suitable metal working process for making a specified product. Prepare forging models using forging operations.
4.	Explain the principles of processing ceramic, glass and plastic materials.
5.	Explain the principles of welding, brazing and soldering and suggest a suitable joining technique for obtaining a joint and to prepare various welding joints using arc welding process.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3

ME1006-1.1	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**1**	**-**	**-**	**3**
ME1006-1.2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**
ME1006-1.3	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**1**	**-**	**-**	**3**
ME1006-1.4	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**3**
ME1006-1.5	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**2**	**2**	**-**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	"Manufacturing technology", Foundry, Forming and welding by P. N. Rao, Tata McGraw Hill, New Delhi.
2.	"Manufacturing Engineering Technology", by Scrope Kalpakjian.
3.	"Production Technology", O.P.Khanna

E Books / MOOCs/ NPTEL

1.	Manufacturing Processes: Casting and Joining: https://archive.nptel.ac.in/courses/112/104/112104301/

MATERIAL SCIENCE AND ENGINEERING

Course Code:	**ME1007-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Describe crystallography and distinguish basic imperfections in the crystal structure. Analyse the mechanism of solidification and phase formation & transformation in metals.
2.	Interpret the Iron and carbon system and describe the phases formed in plain carbon steels and cast iron under equilibrium and non-equilibrium conditions
3.	Describe the behaviour of metals under applied thermal and mechanical loads. Describe the effect of chemical composition/constituents on microstructure, mechanical properties of steel, cast iron, aluminium alloys, copper alloys and composites
4.	Examine the cooling curve, microstructure, hardness and impact energy of carbon steel subject to solidification, heat treatment and various operating temperature respectively
5.	Examine the effect of loading conditions such as tensile, compression, shear, bending and creep on the elastic and plastic behaviour of metals and alloys

UNIT-I

Crystallography	**07 Hours**

Content: Fundamental Concepts of the unit cell, the Crystal structure of crystalline solids, X-ray diffraction technique for determination of crystal structures, Crystal imperfections-point, line, surface & volume defects

Solidification	**09 Hours**

Content: Fundamentals of solidification, cooling curves and free energy, nucleation and its types, crystal growth, cast structure. Phase diagrams: Solid solutions, Types, Rules governing the formation of solids

solutions, phase rule, construction of phase diagrams, interpretation of equilibrium diagrams, Types of phase diagrams. Lever rule, Problems on Phase diagrams	
UNIT-II	
Fe-FeC3 system	**06 Hours**
Content: Iron carbon equilibrium diagram, Micro-constituents in the Fe–C system, Invariant reactions, critical temperatures, Microstructure of slowly cooled steels, ferrite & Austenite stabilizers.	
Non-equilibrium diagrams	**05 Hours**
Content: construction of TTT diagram, TTT diagram for eutectoid, hypo & hypereutectoid steels, the effect of alloying elements, CCT diagram, Hardenability, Jominy end quench test	
Heat treatment processes	**04 Hours**
Content: Annealing and its types, normalizing, hardening, tempering, martempering, austempering. surface hardening: case hardening, carburizing, cyaniding, nitriding, Induction hardening	
UNIT-III	
Mechanical metallurgy	**05 Hours**
Content: Tensile test: Plastic deformation, slip and twinning. Fracture: types, stages in cup & cone fracture, Griffith's criterion. Notch effect, ductile-brittle transition, fatigue tests, mechanism, S-N curves, Factors affecting fatigue life, and protection methods. Creep: Various stages of creep, Mechanisms of creep, the effect of temperature, creep fracture.	
Engineering Alloys	**04 Hours**
Content: Steel: Method of designation as per AISI–SAE. Properties, composition, and uses of the low, medium, and high carbon steels. Cast irons: Microstructures & properties of White CI, Grey CI. Copper & its alloys: Brasses & Bronzes. Light alloys: Aluminum, Magnesium & Titanium alloys. Advanced Materials: Ceramics, Polymers, Composites materials, classification based on matrix and reinforcement types, applications	

Suggested List of Experiments	
1.	Demonstration of the method and procedure of recording the temperature of a solidifying metal or alloy and determining various solidification characteristics from the cooling curve.
2.	Demonstrate the techniques of standard metallographic polishing technique and illustrate the microstructures of eutectoid steels, high carbon steels, Grey cast iron, Ductile iron
3.	Demonstrate DBTT by carrying out an impact test at two temperatures (preferablyroom temperature and 0°C) on carbon steel samples.
4.	Determine the hardness of Jominy end quench samples using a Rockwell hardnestester.
5.	Determine the hardness of ferrous materials such as AISI 1020 steel, cast iron and die steel; non-ferrous materials such as Brass, Bronze and Wrought Aluminum alloy using Brinell and Vickers hardness tester
6.	Carrying out uniaxial low strain rate tensile testing and discussing the elastic and plastic deformation, yielding, strain hardening and fracture in steels.
7.	Carrying out compression tests of steel and cast iron samples and demonstrating the difference in the behaviour of the material under compressive loads.
8.	Carrying out room temperature creep tests and discussing various stages in creep and mechanisms in creep.

9.	Carrying out single and two point bend tests on wood and mild steel bar respectively and discussing the elastic and plastic behavior of the materials during bending loads**.**

Course Outcomes: At the end of the course student will be able to

1.	Describe basic crystal structures and techniques of its determination. Categorize various defects/ imperfections in materials.
2	Describe phase nucleation, crystal growth and development of microstructure during solidification. Formulate binary phase diagram from fundamentals of cooling curves. Analyse the mechanism of solidification, phase formation and transformation using a cooling curve.
3	Identify different phases in the Iron carbon diagram for steels and cast iron from the given iron-carbon phase diagram. Apply the principle of TTT/CCT to describe the effect of various heat treatments on microstructure and mechanical properties Demonstrate the effect of cooling rate, working temperature on the microstructure and hardness and impact energy of carbon steels.
4.	Describe the effects engineering loading conditions have on the mechanical behaviour of metals and apply it to identify the types of failures occurring in metals due to uniaxial stress, fatigue and creep. Demonstrate the behaviour of various metals under various loading and testing conditions
5.	Categorize the influence of chemical composition on the properties of common metals and describe the applications of various ferrous, non-ferrous and composite materials. Distinguish the engineering materials based on their mechanical properties and behaviour under operating conditions. Determine the hardness of ferrous materials such as AISI 1020 steel, cast iron and die steel; non-ferrous materials such as Brass, Bronze and Wrought Aluminum alloy

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1007-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**3**
ME1007-1.2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**	**1**	**1**	**3**
ME1007-1.3	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**	**1**	**-**	**3**
ME1007-1.4	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**	**2**	**-**	**3**
ME1007-1.5	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**	**1**	**-**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	"Essentials of Materials Science and Engineering", Donald R. Askeland, Pradeep P. Phule Thomson-Engineering, 2006.
2.	"Materials Science & Engineering- An Introduction", William D. Callister Jr. Wiley India Pvt. Ltd. 6th Edition, 2010, New Delhi.
3.	"Introduction to Physical Metallurgy", Sidney H Avner, Tata-McGraw Hill Education, 2nd Edition

REFERENCE BOOKS:

1.	"Steels: Microstructure and Properties", Harry Bhadeshia and Robert Honeycombe, 3rd Edition, Elsevier Ltd.
2.	"Mechanical Metallurgy", George. E. Dieter, Third Edition, McGraw Hill Education, July 2017, Indian Edition

3.	"Alloying-Understanding the Basics", J.R Davis, ASM International, 2001, Materials Park, Ohio
E Books / MOOCs/ NPTEL	
1.	NOC:Introduction to Materials Science and Engineering, IIT Delhi by Prof. Rajesh Prasad. https://nptel.ac.in/courses/113102080
2.	Virtual labs- Strength of materials-NITK- https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html
3.	Virtual labs- Creep transient of materials-IITK - https://mrmsmtbs-iitk.vlabs.ac.in/exp1.html

Automotive Engineering

Course Code:	**ME2001-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1003-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Get an idea on the different components of an engine and its types with lubrication system.
2.	Understand the fuel supply system and ignition systems used in automobiles.
3.	Demonstrate the working of the transmission system.
4.	Explain the importance of suspension system, steering geometry and drives in automobiles
5.	Know the concept of braking system, tyres and emission control.

UNIT-I

ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS	**07 Hours**
Content: SI & CI engines, Cylinder-arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, Choice of materials for different engine components, cooling requirements, methods of cooling, different lubrication arrangements, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor	
FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES:	
Content: Fuel mixture requirements for SI engines, types of carburettors, simple carburettor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, fuel injection pumps and injectors, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors, Turbocharger construction and operation.	
IGNITION SYSTEMS	**09 Hours**
Content: Battery Ignition systems, magneto Ignition system, Electronic Ignition, Automatic Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive).	

UNIT-II

POWER TRAINS:	**07 Hours**
Content: Clutches- Single plate, multiplate, Gear box: Necessity for gear ratios in transmission, Constant mesh gear box, Synchromesh gear box, over drive, fluid coupling and torque converter, principle of automatic transmission, Vehicle Speed Sensors, calculation of gear ratios.	
DRIVE TO WHEELS	
Content: Propeller shaft, universal joints, Hotchkiss. And torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe-in & toe-out, condition for exact steering, steering gears, power steering, over steer, under steer & neutral steer, Steering angle sensors	
SUSPENSION AND SPRINGS:	**08 Hours**
Content: Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system.	

UNIT-III	
BRAKES:	**05 Hours**
Content: Types of brakes, mechanical, compressed air and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes	
TYRES:	**04 Hours**
Content: Desirable tyre properties, Types of tyres.	
AUTOMOTIVE EMISSION:	
Content: Automotive exhaust emissions, sources and emission control method: EGR, SCR, Emission Standards, Exhaust sensors.	
Electric Vehicles	
Content: Introduction.	

Suggested List of Experiments

1	Study of Automotive - Chassis & superstructure/body and its functions. Also involves study of cut section of wheel & tyres (bias and radial types).
2	Study of more commonly used tools and equipment in automotive shop.
3	Study of carburetors and petrol & diesel fuel injection systems
4	Demonstration and study of Front axle and steering system
5	Demonstration and study of various suspension systems
6	Power train - Dismantling and assembly of single/multi cylinder Engine.

Demonstration Experiments

1.	Demonstration and study of brake mechanism (hydraulic type) and study of disc and drum brakes
2.	Power train - Study of clutch mechanism. Demonstration and study of dry friction clutches - Single plate & multi-plate types
3.	Power train - Demonstration and study of transmission system - Gear box
4.	Power train - Demonstration and study of Universal joints, propeller shaft, final drives, differential, and rear axles

Course Outcomes: At the end of the course student will be able to

1.	Describe and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
2.	Explain and demonstrate the fuel supply and Ignition systems for SI and CI engines.
3.	Describe and demonstrate the transmission system
4.	Explain and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
5.	Describe and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2001-1.1	**3**	**1**		**-**	**-**	**1**	**-**	**-**	**3**	**1**	**-**	**1**	**-**	**-**	**3**
ME2001-1.2	**3**	**1**		**-**	**-**	**1**	**-**	**-**	**3**	**1**	**-**	**1**	**-**	**-**	**3**
ME2001-1.3	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**3**	**1**	**-**	**1**	**1**	**-**	**2**
ME2001-1.4	**2**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**3**	**1**	**-**	**1**	**1**	**-**	**2**
ME2001-1.5	**3**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**3**	**1**	**-**	**1**	**1**	**-**	**2**
1: Low 2: Medium 3: High															

TEXTBOOKS:

1.	Automotive Mechanics by S. Srinivasan, Tata McGraw Hill, 2003
2.	Automobile Engineering, Kirpal Singh, Vol I and II, 2013.
3.	Automotive Electrical and Electronics, A. K. Babu, Khanna Publishers, 2nd edition, 2016

REFERENCE BOOKS:

1.	Automobile Engineering, R. B. Gupta, Satya Prakashan, 4th Edn., 1984 .
2.	Automobile Engineering, Narang, Khanna Publishers 2002
3.	Automotive Mechanics, Crouse, McGraw Hill 2002
4.	Automotive Mechanics, Joseph Heithner 2000
5.	Automobile Mechanics by N. K. Giri, Khanna publishers 2002
6.	Newton and Steeds Motor Vehicle, Butterworth, 2nd Edn. 1989.
7.	Automobile Engineering by K. K. Jain and R. B_ Arshana, Tata McGraw Hill, 200
8.	Automobile Mechanics, A.K. Babu & S.C. Sharma, T.R. Banga, Khanna Book Publishing
9.	A Textbook of Automobile Engineering, R.K. Rajput, Laxmi Publications
E Books / MOOCs/ NPTEL	
1.	Fundamentals of Automotive Systems

Collaborative Robotics in Manufacturing Aided by AI, ML & IIOT

Course Code:	**ME2002-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S : J):	**2:0:2:0:2**	**Credits:**	**04**
Total Teaching Hours:	**30+0+26+0+30**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1103-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To get acquainted with various Robotic configurations and Robotic programming features
2.	To learn the vital components of Mechatronics systems, Robotic Design aspects, and Interfacing
3.	To understand the need for Robotics in Manufacturing applications and design of Robotic system
4.	To Interface the mechanical moving components with electronic circuits.

UNIT-I

Sensor technologies in M/C tools & Robots — **06 Hours**

Evolution of Mechatronics and its importance, Range of sensors from Domestic appliances to Machinery on the shop floor, Sensors in Machine tools, Sensors in e Robots, Standards & specifications of sensors, Interfacing sensors in a CNC Machine for Tool life monitoring, and advanced Mechatronics systems in Machines.

Open & closed-loop control systems, Digital Motors, Servo Motors, Characteristics, Various electrical drives in powering different machine tools, and Troubleshooting in Electrical Drives.

Industrial Fluid systems — **06 Hrs**

Hydraulic actuators for heavy and light-duty applications, Pneumatic actuators for Machine tools, Hydro Pneumatic Actuators, Intensifiers, and Accumulators in Fluid system applications.

Essential Pneumatic and Hydraulic circuit components, Hydraulic and Pneumatic circuits for cascading operations in machine tools, Design of Electro- Hydro-Pneumatic Circuits, A fluid system for Robot, Fluidics and Logic circuits in Machine tools, and Trouble Shooting in the Drive system.

UNIT-II

Robotic engineering — **06 Hours**

Robotic configurations, Robotic grippers with sensing capabilities, Robot Kinematics and Control, Mentoring the robots, Robot Programming relevant to Industrial applications, and Robotic Intelligence in Manufacturing.

Robotic Vision sensors, Frame Grabbing, Sensing and Digitizing, Image Processing, Enhancement, Object recognition & Algorithms, Robot operating systems, and Applications of Robotic vision systems

Robotic Design considerations — **06 Hours**

Materials used in the Fabrication of a Robot, Selection and Design Criteria, Application-based Grippers and their design, Energy Supply to Robots, and Robot communication

Automated Guided Vehicles, Types of AGVs, Traffic management & Control, Rail Guided Vehicles, and Applications of robots in various fields.

UNIT-III

Interfacing and Simulation	**06Hours**

Micro Processors, Microcontrollers, and Programmable Logic Controllers. Mechatronics system design, Utilizing IoT in Mechatronics systems, Data Applications in Manufacturing, Embedded systems, and the Role of Fuzzy logic in Manufacturing.
Design of Robot link using MAT Lab Simulink and Design of RR Robot Forward Kinematics using MAT Lab Simulink

Suggested List of Experiments

1	Anatomy of robot.
2	Robot Specifications.
3	Demonstration of the proto-type model of different robot configurations.
4	Transformation matrix concepts. Rotation & Translation transformations . Rotation about arbitrary axis transformations.
5	Pre & Post Multiplications.
6	Links & Joints descriptions
7	Kinematics Relationship between adjacent joints.
8	Denavit-Hertenberg (D-H) representation & Problems
9	Hands on programming on Robot Studio for, Pick and place operation. Painting operation. Spot & Seam welding operations.

Demonstration Experiments

1	Demonstration of pick and place with camera.
2	Demonstration of pick and place with without camera.

Course Outcomes:

1.	Understand different configurations, sensors, actuators, and fluid systems
2.	Apply the combination of sensing, driving, and controlling systems to bring about automation.
3.	Design, Analyze and develop a hydraulic system for Industrial Applications
4.	Analyze the Kinematic transformations of Robotic configurations.
5.	Develop a robot for specific tasks.digital

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2002-1.1	**3**	**2**	**2**										**3**		**3**
ME2002-1.2	**3**	**2**	**2**				**2**						**3**		**3**
ME2002-1.3	**3**	**2**											**3**		**3**
ME2002-1.4	**3**	**3**	**3**				**2**						**3**	**2**	**3**
ME2002-1.5	**3**	**3**	**2**		**2**		**2**						**3**		**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Fundamentals of robotics – Analysis and control- Robert. J. Schilling, Prentice Hall of India 1996.
2.	Introduction to Robotics (Mechanics and control), John. J. Craig, Pearson Education Asia 2002.

3.	Fluid Power with Applications-Anthony Esposito- Pearson Publications
REFERENCE BOOKS:	
1.	Pneumatic Control for Industrial Automation‖, Peter Rohner & Gordon Smith, John Wiley and Sons, 1987
2.	Fundamentals of Digital Manufacturing Science- Zude Zhou, Shane (Shengquan) Xie, Dejun Chen – Springer
3.	Pneumatic Control for Industrial Automation‖, Peter Rohner & Gordon Smith, John Wiley and Sons, 1987
E Books / MOOCs/ NPTEL	
1.	https://www.automate.org/robotics
2.	https://www.ieee-ras.org/
3.	https://www.twi-global.com/Digital Manufacturing

Technology and Processes in Heavy Manufacturing

Course Code:	**ME2003-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S:J):	**2:0:2:0:2**	**Credits:**	**4**
Total Teaching Hours:	**30+0+26+0+30**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Describe cutting-edge concepts for the manufacture of process equipment and capital goods
2.	Assess the practical constraints of heavy manufacturing's primary and secondary processes
3.	Outline the Fluid Power Industrial Application Circuit in detail
4.	Describe the major manufacturing activities of a typical pressure vessel
5.	Summarize the ASME codes for forgings and castings
6.	Outline the various technologies used in industry for welding automation

UNIT-I

Primary manufacturing of Heavy Equipment and Material Selection	**6 hrs**

Process Plant Equipment -Introduction to Primary Manufacturing, Classification of Process Plant Equipment in various Industrial Sectors, Overview of typical process and Plant & Equipment Layout of Refinery, Petrochemical, Fertilizer, and Power Plant; Quality in Manufacturing, Brief overview of Quality control checks in the manufacturing industry

Selection of Material- Mechanical and Thermal properties affecting the Design Process; Microstructure variations with alloying element; Effect of Processing Route on Material Properties; Selection of Material for specific Applications- Strength, Stiffness, deflection, Cost & energy; Use of Polymeric Composite in Industrial appliances

Casting Technology -Introduction, Technology of mould and core making; Special sand molding processes; Design- Gating, Riser; Special casting, Overview of ASME codes for Casting

Heavy Metal Forming	**6 hrs**

Heavy Forging - Forgeable Materials; Steel Melting and Ingot casting; Open and closed die forging; Forging temperature of different class of materials; Forging defects; Overview of ASME codes for Forgings

Heavy Sheet metal forming – Surface development; Cylindrical shell forming; Conical Shell forming; Dished End forming; Bending process- Tube bending, Pipe bending, Plate bending;

UNIT-II

Welding terminology, Procedure qualification, Welding process and Post Weld treatment	**6 hrs**

Welding terminology and Procedure qualification- Types of joint and symbol; Welding position; Base Metal, Filler Metal and Weld metal- classification (P, F, A numbering); Welding Procedure Specification (WPS) and Procedure Qualification Records (PQR); Welding Consumable Specifications; Welding defects and distortion analysis

Welding Process - Shielded Metal Arc Welding (SMAW); Gas Tungsten Arc Welding (GTAW); Gas Metal Arc welding (GMAW); Flux Cored Arc Welding (FCAW); Submerged Arc Welding (SAW); Electro Slag Strip Cladding (ESW Strip Cladding); Submerged Arc Strip Cladding (SASC); Plasma Arc Welding; Laser Beam Welding; Electron beam welding; Resistance Welding

Special type of Welding- Thermite Welding; Friction Stir Welding; Tandem Welding; Explosive Welding; Multi pass welding; Welding Parameters in quality Welds

Post Weld treatment- Stress Relieving; Normalizing; Tempering; Types of furnace

Machining process and Fluid Power System in Production	**6 hrs**

Machining - Mechanism of Material Removal; Tool wear and Tool life; Machining operations- Turning, Boring, Milling; Special Machining Process- Deep Hole Drilling, Gang Drilling, Jig Grinding, Jig Boring; Complex shape Machining - Thread machining, Thread Whirling;

Special machining and Manufacturing- Shear Cutting; Water jet cutting; Plasma Arc Cutting; Laser Cutting; Shrink Fitting; Tube to T/S joint Expansion; Electro discharge machining; Machining of FRP and Ceramics

UNIT-III

Fluid power System in Production , Manufacturing Cycle, Quality control and IOT in Welding	**6 hrs**

Fluid power System in Production - Components of fluid power system; Fluid power generation; Control Valves; Industrial Application circuits- Tool and workpiece motion control; Hydraulic circuit for – Drilling head, Hydraulic press, clamping and forklifting circuit; Servo valves Application circuits; Pneumatic application circuits

Manufacturing cycle for Pressure Vessel -Construction and Type of Service in Pressure vessel; Components in Pressure Vessel; Manufacturing lifecycle of Pressure vessel; Metal forming of petals; Metal Coating; Refractory coatings and painting;

Quality Control - Design for Inspection; Non-destructive Inspection; Dimensional check; Destructive Testing

IOT in Welding – Industry 4.0, Automation in Welding- different technologies used for welding automation; Digitalization

Suggested List of Experiments

1	Machining exercises on lathe: Prepare models which involve different turning and thread cutting operations (3 models).
2	Machining exercises on Milling machine: Spur gear milling
3	Machining exercises on shaping machine: One model
4	Machining exercises on grinding machine: Cylindrical and surface grinding

Course Outcomes: At the end of the course student will be able to

1.	Describe the information on various ferrous materials properties and industrial applications.
2.	Demonstrate practical knowledge of the various shop floor practices used in forming process in the heavy manufacturing.
3.	Discuss the international codes and standards that are used in welding of specimens
4.	The significance of using appropriate tools and machines in metal cutting industries.
5.	Create an Industrial application hydraulic circuit and judge the appropriate automation technique for an application.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
1	1			3			2	1					3		2
2				2		2							3		1
3						3	1	3					3		
4					2			2				1	2		2
5						2						1	1		1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Practical guide to Pressure vessel manufacturing – Sunil Pullarcot- Marcel Dekker Inc, CRC Press
2. Fabrication of Metallic Pressure Vessels - Owen R. Greulich, Maan H. Jawad – Wiley Publisher- ASME Press

REFERENCE BOOKS:

1. Manufacturing- Engineering Technology- Serope Kalpakjian, Steven R Schmid
2. An Introduction to Materials Engineering and Science for Chemical and Materials Engineers - Brian S. Mitchell – Wiley Publisher
3. ASME Boiler and Pressure Vessel Code- An International Code- SECTION VIII Rules for Construction of Pressure Vessels
4. ASM Handbook- Volume 15 Casting

Finite Element Methods

Course Code:	**ME3001-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1102-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Define FEM, classify various elements used in FEM and study node numbering and stress strain relationships.
2.	Determine the deflection and stress at various points on cantilever, simply supported and fixed beams using Rayleigh-Ritz and Galerkin's method.
3.	Understand various displacement polynomials using Pascal's triangle and obtain shape functions for different elements.
4.	Implement the steps required for FEM to obtain appropriate solution to a variety of physical systems (Bar and truss) and obtain engineering design parameters.
5.	Make use of direct method of analysis for analyze deflection and slope in beams and stress strain relationships in plates.

UNIT-I

16 Hours

Introduction: Definition of FEM, General Description of FEM, Engineering applications of FEM, Discretization process, Types of Elements – 1D, 2D, 3D and Axisymmetric elements, location of nodes, node numbering scheme, boundary conditions, half band width, stiffness matrix of bar elements by direct method, properties of stiffness matrix, preprocessing, post processing. Displacement of 3D Elastic body, Differential equations of equilibrium of stresses at a point, strain displacement relations, stress – strain relations for plane stress and plane strain.
Principle of minimum potential energy, Rayleigh – Ritz method, Galerkins Method, Numerical Integration.

UNIT-II

16 Hours

Displacement models: Displacement models, Pascal Triangle - displacement functions for higher order quadrilateral & triangular elements, Shape functions, Derivation of Shape function for 1D linear element, quadratic element, CST element, Convergence & its types.
Finite element formulation of 1D linear element, Numerical problems on bars, stepped bars - solution of displacements, reactions and stresses by using elimination approach, penalty approach. Stress and strain in plane truss by direct stiffness method, Numerical problems.

UNIT-III

08 Hours

Beams: Beams, Hermite Cubic polynomial function, Finite element formulation of beam element, Numerical problems on beams. Stress-strain analysis of 2D structural problems, Modeling of the plate continuum using triangular elements, Isoparametric formulation of CST elements. Derivation of Stress – Displacement Matrix, Derivation of Element matrices, Numerical problems

Suggested list of experiments

1	Static finite element analysis of Bars, with constant cross section area, tapered cross section area and stepped bar, Multipoint Constraints, Temperature Stresses in 1D Bars.
2	Static finite element analysis of different type of Truss element
3	Determining shear force and bending of Beams – Simply supported, cantilever beams with UDL, beams with varying load etc
4	Stress analysis of a rectangular plate with a circular hole subjected to both axial and bending.
5	Stress analysis of an axi-symmetric component
6	1. Modal and Harmonic analysis. 2. Thermal Stress analysis of 2D component.
7	Heat Transfer Analysis – 2D problem with conduction and convection Boundary conditions.
8	Fluid flow analysis using ANSYS Workbench

Self learning: 3D modelling and analysis of unprotected and protected type flanged couplings

Course Outcomes: At the end of the course student will be able to

1.	Understand the terminologies and basic concepts of FEM along with advantages, disadvantages and its applications for various engineering fields. Perform modal analysis to determine modal frequencies and mode shapes along with harmonic analysis of various types of beams subjected to different loads. Perform thermal analysis to determine thermal stresses and temperature distribution for 2D plates.
2.	Apply the knowledge of mathematics that involves differentiation, integration and engineering fundamentals to solve various engineering problems.
3.	Discuss the various approaches to assume displacement models. Derive the shape functions for various basic and higher order 1D and 2D elements. Discuss the concept of convergence and its types.
4.	Apply knowledge of mathematics and engineering fundamentals to solve problems related to bars and trusses for determining nodal displacements, element stresses and reaction supports. Verify the above parameters using Ansys APDL software.
5.	Apply knowledge of mathematics and engineering fundamentals to solve problems related to beam elements for determining deflection and reaction supports. Plot shear force and bending moment diagrams for various types of beams subjected to various types of loads using Ansys APDL software. Apply knowledge of mathematics and engineering fundamentals to solve problems for determining element stiffness matrix and stress displacement matrix for plate elements.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME3001-1.1	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**		**2**	**1**	**-**
ME3001-1.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**2**	**-**	**-**
ME3001-1.3	**3**	**2**	**-**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**-**	**3**	**3**	**-**	**-**

ME3001-1.4	3	3	-	2	3	-	-	-	2	3	-	3	3	-	-
ME3001-1.5	3	2	-	-	3	-	-	-	2	3	-	3	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Finite Element Methods, Daryl L. Logon, Thomson Learning 6th edition, 2015.
2.	Introduction to Finite Elements in Engineering, Chandrupatla T. R., 4th Pearson edition, 2014.

REFERENCE BOOKS:

1.	The finite element method in Engineering, S S Rao, 5th edition, 2013
2.	Introduction to the Finite Element Method, C. S. Desai and J.F. Abel
3.	Finite Element Analysis – Theory & Programming, Krishnamoorthy C.S
4.	Numerical Methods in Finite Element Analysis, Bathe K. J & E. L Wilson
5.	Higher Engineering Mathematics, B. S. Grewal

E Books / MOOCs/ NPTEL

Heat Transfer

Course Code:	**ME3002-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Get the idea of modes of heat transfer and their governing laws and steady state heat conduction equations.
2.	Know the importance of application of fins in heat transfer equipment's and understand unsteady conduction.
3.	Understand radiation and laws governing them and to know the application of boundary layer concept to heat transfer.
4.	Conduct experiments related to steady state conduction and heat exchangers.
5.	Conduct experiments related to free and forced convection , radiation and concepts of boiling and condensation.

UNIT-I

Introductory Concepts and Definitions:

Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient.

Conduction-Basic Equations:

General form of three-dimensional heat conduction equation in rectangular, coordinate. Discussion (no derivation) on three-dimensional conduction in cylindrical and spherical coordinate systems.

One-Dimensional Steady State Conduction:

Steady state conduction in a slab, in a cylinder and in a sphere without heat generation. Overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation.

07 Hours

Heat Conduction Through Finned Surfaces **08 Hours**

Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin effectiveness and efficiency. **One-Dimensional Transient Conduction:** Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of transient Temperature charts (Heisler's Charts) for transient conduction in slab, long cylinder, and sphere.	
UNIT-II	
Radiation Heat Transfer: Thermal radiation: Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law' Radiation heat exchange between two parallel infinite black surfaces (no derivation, equation only) between two parallel infinite nonblack surfaces (derivation) Effect of radiation shield; Intensity of radiation and solid angle; Lambert's Law. **Concepts and Basic Relations in Boundary Layers:** Flow over a body-Velocity boundary layer; Critical Reynolds number; General expressions for drag coefficient and drag force; Thermal boundary layer; general expression for local and average heat transfer coefficient; Nusselt number. Expressions for friction factor for hydro dynamically developed laminar flow through tubes.	**07 Hours**
Forced Convection: Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl and Nusselt numbers. Use of various correlations for hydro -dynamically and thermally developed external and internal flows. **Free or Natural Convection:** Application of dimensional analysis for free convection- physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal flat plates, vertical and horizontal cylinders and spheres.	**09 Hours**
UNIT-III	
Condensation and Boiling: Types of condensation; Nusselt's theory for laminar condensation on a vertical flat surface-expressions for film thickness and heat transfer coefficient; use of correlations for condensation on inclined flat surfaces, horizontal tube, and horizontal tube banks; Reynolds number for condensate flow; Regimes of pool boiling-Pool boiling correlations. .	**05 Hours**
Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers	**04 Hours**

Suggested List of Experiments

1	Thermal Conductivity of Metal Rod
2	Thermal Conductivity of Insulating Powder
3	Thermal Conductivity of Liquid
4	Heat Transfer Through Composite Walls
5	Heat Exchangers
6	Thermal Conductivity of Metal Rod
7	Thermal Conductivity of Insulating Powder
8	Thermal Conductivity of Liquid
9	Heat Transfer Through Composite Walls

10	Natural Convection
11	Pin-Fin Natural Convection
12	Pin-Fin Forced Convection
13	Stefan Boltzman Constant Apparatus.
14	Emissivity Measurement of Radiating Surface
15	Vapour Compression Refrigeration
16	Condensation in Dropwise and Film wise Forms

Course Outcomes: At the end of the course student will be able to

1.	Apply the basic knowledge of mathematics, science, and engineering to understand and analyze the basic laws, principles, and modes of steady state conduction. Conduct the experiments on steady state heat conduction through composite planes, composite cylinders, composite spheres, metal rod, insulating powder and liquids. Calculate the temperature distribution and rate of heat transfer.
2.	Understand and analyze complex engineering problems related to finned surfaces and unsteady conduction. Conduct experiment on finned surface and detrmine fin effectiveness
3.	Apply engineering knowledge to solve complex problems of radiation heat transfer and radiation shielding to create sustainable environment.Understand the principles of boundary layer theory.
4.	Apply principes of boundry layer theory and Buckingham's π theorem to free and forced convection heat transfer and to design suitable solution to complex problems. Conduct natural convection and forced convection experiments and determine heat transfer coefficients and rate of heat transfer.
5.	Analyze and interpret complex problems related to boiling and condensation, and design of heat exchangers using LMTD and NTU methods. Derive the expressions for the effectiveness of parallel flow and counter flow heat exchangers, also determine them experimentally.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME3002-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**1**	**3**	**-**
ME3002-1.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**3**	**-**
ME3002-1.3	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**1**	**3**	**-**
ME3002-1.4	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**3**	**-**
ME3002-1.5	**2**	**2**	**-**	**-**	**-**	**-**		**-**	**2**	**2**	**-**	**-**	**-**	**3**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Heat Transfer, Holman J.P., Ninth Edn. Tata McGraw –Hill, 2007.
2.	Fundamentals of Heat Exchanger Design, Shah, R. K. and Seculic, D. P Wiley India, 2012.
3.	Fundamentals of Heat Transfer, Krieth, 4th Edition, Harper & Law, 1986.
4.	Heat & Mass Transfer by R.K. Rajputh, S. Chand & Co (P) Ltd, 2014.
5.	Heat & Mass Transfer by S.C.Arora & S. Domkundvar, Dhanapat Rai Co (P) Ltd, 2013.
6.	Heat Transfer - A Basic approach by M Necati Ozisik, McGraw Hill International edition 1988.
7.	Numerical Heat Transfer and Fluid Flow. Hemisphere Publishing Corporation, Taylor and Francis Group New York, 1980.

REFERENCE BOOKS:

1.	Thermal Engineering, M.L. Mathur & F.S. Mehta, Jain Publications

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/112101097/

Professional Core Courses (Theory)

Engineering Metrology

Course Code:	**ME1101-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand metrology, its objectives & measuring instruments,
2.	Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators
3.	Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices.
4.	Understand the measurement of Force, Torque, Pressure, Temperature and Strain.
5	Equip with knowledge of limits, fits, tolerances, and gauging

UNIT-I

Introduction to Metrology	**07 Hours**

Definition and Objectives of metrology, Standards of length -International prototype meter, Wavelength standard, subdivision of standards, line and end standard comparison, Slip gauges, Wringing phenomena, Indian Standards (M-87, M-112), Numerical problems on building of slip gauges. Definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, and linearity, Errors in Measurements.
Angular measurements: Bevel Protractor, Sine Principle and use of Sine bars, Sine centre, use of angle gauges, (numerical on building of angles). Interferometer: Principle of Interferometry, autocollimator, Optical flats.

Screw threads:	**09 Hours**

Terminology, measurements of major diameter, minor diameter, pitch, thread angle. Effective diameter of screw threads by 3-wire methods - Best size wire. Gear terminology- use of gear tooth Vernier calliper and gear tooth micrometer.
Comparators: Introduction to Comparators, Classification and Characteristics of comparators. Principles of mechanical, optical, electrical & electronic, and pneumatic comparators. Working of Dial indicator, Zeiss, LVDT and Solex comparators.

UNIT-II

Measurement systems:	**06 Hours**

Generalized measurement system, hysteresis, loading effect. Transducers, Transfer efficiency, Primary and Secondary transducers, electrical, Mechanical, electronic transducers, advantages of each type transducers.
Intermediate modifying and terminating devices: Mechanical systems, inherent problems, Electrical intermediate modifying devices, input circuitry, ballast, ballast circuit, electronic amplifiers and telemetry. Terminating devices, Mechanical, Cathode Ray Oscilloscope, Oscillographs.

Measurement of Force, Torque, and pressure	**04 Hours**

Principle of analytical balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, McLeod gauge

Temperature and strain measurement:	**04 Hours**

Thermocouple, law of thermocouple, materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge preparation and mounting of strain gauges, gauge factor. Berry strain gauge, electrical resistance strain gauge

UNIT-III

System of limits, Fits, Tolerances, and gauging	**05 Hours**

Definition of tolerance and its Specification in assembly, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963,) Principle of interchangeability and selective assembly, limits of size, standards, hole basis system, shaft basis of system. Numerical problems on limit fits and tolerances..

concept on design of gauges	**05 Hours**

Brief concept on design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials

Course Outcomes: At the end of the course student will be able to

1.	Explain the types of length standards used in engineering measurements and angle measurement.
2.	Explain the terminology of screw threads and gears and their measurement techniques and describe working principle comparators.
3.	Describe the elements of generalized measurement system and working of transducers elements.
4.	Explain the instruments used for the measurement of force, torque, pressure, temperature, and strain.
5.	Describe types of fits according to IS: 919-1963 and types of gauges to inspect the fits.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
ME1101-1.1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME1101-1.2	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME1101-1.3	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME1101-1.4	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME1101-1.5	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Mechanical measurements" by Beckwith Marangoni and Lienhard, Pearson Education, 6thEd., 2006
2. "Engineering Metrology" by R. K. Jain, Khanna Publishers

REFERENCE BOOKS:

1. Engineering Metrology" by I. C. Gupta, Dhanpat Rai Publications,
2. "Measurement Systems Applications and Design" by Ernest 0, Doblin, McGRAW Hill Book Co.

3.	"A Textbook of Measurements and Metrology" M.Mahajan, Dhanpat Rai &Co.2014.
4.	Mechanical measurements & Metrology Dr. T Chandrashekhar
E Books / MOOCs/ NPTEL	
1.	http://nptel.ac.in/courses/112105182/
2.	http://nptel.ac.in/courses/112104117/

Mechanics of Materials

Course Code:	**ME1102-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the concept of stress and strain and analyze the variation of stress for constant and varying cross section bars.
2.	Analyze the volumetric strain for simple bars and obtain elastic constants, analyze circumferential and longitudinal stresses and volumetric strain in thick and thin cylinders
3.	Analyze and draw Shear force and Bending Moment diagrams for varying loads and types of beams.
4.	Understand the theory of simple bending, analyze the bending and shear stresses in beams of symmetrical cross sections
5	Apply Macaulay's method and double Integration method to determine deflection and slope in various beams, study the concept of pure torsion and apply the same for evaluating power transmitted and shear stresses produced for a given torque.

UNIT-I

Simple stress and strain	**07 Hours**

Introduction, stress, strain, Mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behavior in Tension for Mild steel and nonferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps bars with continuously varying cross sections (circular and rectangular) Elongation due to self-weight, Principle of superposition.

Volumetric strain and Thick & thin cylinders:	**09 Hours**

Volumetric strain, expression for volumetric strain and numerical elastic constants, simple shear stress, shear strain Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation.

UNIT-II

Bending moment and Shear force in beams:	**06 Hours**

Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, Uniform distributed load (UDL) and couple for different types of beams.

Bending stress in beams:	**04 Hours**
Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section.	
Shear stress in beams	**04 Hours**
Shearing stresses in beams, shear stress across rectangular, circular and symmetrical I and T sections.	
UNIT-III	
Deflection of beams:	**06 Hours**
Introduction, differential equation for deflection, Equations for deflections, slope and moments, Double integration method/ Macaulay's method for cantilever and simply supported beams for point load, UDL and Couple.	
Torsion of circular shafts:	**04 Hours**
Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, and simple problems	

Course Outcomes: At the end of the course student will be able to

1.	Analyze the state of internal effects such as deformation, stress and strains caused due to external load acting on bars of constant and varying cross sections; calculate net deformation of compound bars subjected to loads acting with varying magnitudes in different directions using the principle of superposition.
2.	Determine volumetric strain and elastic constants for a bar material subjected to loads acting along 3 mutually perpendicular directions; Calculate the stresses and strains due to fluid pressure acting on walls of thick and thin cylinders due to fluid pressure
3.	Calculate the shear forces and bending moments and draw the corresponding diagrams for cantilever, simply supported and overhanging beams subjected to point load, uniformly distributed load and couple
4.	Compute the bending stress and shear stress and draw the corresponding stress distribution diagrams for I section and T section of beam.
5.	Apply Macaulay's method and Double Integration method to calculate slope and deflections for beams subjected to point load, uniformly distributed load and couple. Determine torsional stress and power transmitted for solid and hollow circular shafts subjected to pure torsion.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1102-1.1	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**1**
ME1102-1.2	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**-**	**1**	**1**
ME1102-1.3	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**1**
ME1102-1.4	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**1**
ME1102-1.5	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Punmia B.C, Ashok Kumar Jain, Arun Kumar Jain, "Strength of materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd.,2015
2.	Mechanics of materials, by Ferdinand P. Beer, E. Russell Johnson, Jr. John T.Dewolf, McGraw Hill Internationa
REFERENCE BOOKS:	
1.	Strength of Materials by S.S. Bhavikatti, 4th edition, Vikas Publications, 2013.
2.	Strength of materials by S. Ramamrutham, 2012.
3.	Mechanics of Materials, by E.P.Popov, Prentice Hall India Pvt. Ltd. 1978
4.	Engineering Mechanics by Timoshenko & Young, Tata McGraw Hill Book publishing co.ltd. 1985
5	Mechanics of Materials, by James Gere – Thomson learning
E Books / MOOCs/ NPTEL	
1.	https://www.coursera.org
2.	https://freevideolectures.com/course/4545/nptel-mechanics-materials
3.	https:// www.classcentral.com
4	https://www.udemy.com
5	https:// www.nptel.ac.in

Theory of Machines

Course Code:	**ME1103-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Improve the engineering knowledge by studying mechanism and their inversions that are required to construct a machine with the help of different linkages.
2.	Analyze the forces acting on various links of an engine mechanism and the torque on the crank, Calculate Torque and forces on various links subjected to external forces and to know the necessity of balancing in high speed engines.
3.	Design and analyze the cam system. Understand the effects of gyroscopic couple on an aero plane, know the stability of a four wheel and two-wheeler vehicles in a curved path.
4.	Develop student's ability to understand the basic terminologies of gear and its characteristics. Understand engineering fundamentals of power transmission in gear trains.
5.	Calculate the natural frequency of a single degree freedom system and to model mechanical systems involving springs and masses.

UNIT-I

Introduction	**06 Hours**
Content: Definitions Link or element, Kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanisms (with problems), Inversion, Machine. Inversion of single slider and four bar mechanisms.	
Static force Analysis	**06 Hours**

Content: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, Static force analysis of four bar mechanism and Slider-crank mechanism without friction	
Static Balancing	**04 Hours**
Content: balancing of rotating mass by balancing masses in same plane	
UNIT-II	
CAMS	**07 Hours**
Content: Types of cams, Types of followers, Displacement, disc cam with reciprocating follower having knife edge, roller, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, Uniform acceleration and retardation.	
Gyroscope:	**08 Hours**
Content: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on plane disc, aero plane, stability of two wheelers and four wheelers, numerical problems.	
UNIT-III	
Gears and Gear Trains	**05 Hours**
Content: Gear terminology, law of gearing, Path of contact Arc of contact, Contact ratio of spur gears. Simple gear trains, Compound gear trains for large speed. Epicyclic gear trains. Tabular methods of finding velocity ratio of epicyclic gear trains.	
Mechanical Vibration:	**04 Hours**
Content: Introduction, classification, single degree undamped free vibration including simple problems.	

Course Outcomes: At the end of the course student will be able to

1.	List the terminology connected with kinematics and identifies the mechanisms. Describe the working principle of a given machines
2.	Apply equilibrium conditions on links subjected to external forces and determine the pin forces and torque on different links of a mechanism. Describe and determine the balancing of rotating masses in a system
3.	Design the cam profile for knife edge, roller for the given type of follower motions. Perform analysis of gyroscopes
4.	List the terminologies connected with gears determines the contact ratio. Identify the gear trains and calculate power transmission in gear trains
5.	Calculate the natural frequency of a single degree of freedom system and apply mathematical techniques to model mechanical systems involving springs and masses .

Course Articulation Matrix :
Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1103-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**	**-**	**1**	**2**	**-**	**3**
ME1103-1.2	**2**	**3**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**2**	**0**
ME1103-1.3	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**2**
ME1103-1.4	**2**	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**-**	**1**
ME1103-1.5	**1**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Theory of Machines, by Rattan S.S., Tata McGraw – Hill, 3rd edition 2009.
2. Theory of Machines by Thomas Bevan-CBS Publishers, 3rd edition-2005.
3. Mechanisms and Dynamics of machinery by Mabie and Ocvirk, 4th edition,1987
4. Mechanics of Machines by Ham, Cranes and Rogers, McGraw– Hill, 4th edition, 1958.

REFERENCE BOOKS:

1. Theory of Machines by V.P.Singh, 4rd edition, 2014.
2. Theory of Machines & Mechanisms by Shigley J.V. & Uickers J.J.2nd Edition, 1995.

3.	Theory of Machines by Ballaney, 25th Edition, 2011.
E Books / MOOCs/ NPTEL	
1.	The Theory of machines by J.S.Rao, New Age International Publishers, 2006.
2.	Theory of machines by Sadhu Singh, Pearson Education, 2nd Edition, 2009.
3.	Theory of mechanisms and machines by C.S. Sharma and K.Purohit, Prentice Hall of India Pvt. Ltd., 2006.
4.	Theory of machines-Kinematics and Dynamics by B.V.R. Gupta, I.K. International Publishing house, 2011.
5.	Mechanics of Machines by V.Ramamurthy, CRC Press, Narosa Publishing House, 2002.
6.	https://www.mooc-list.com/course/mechanics-kinematics-and-dynamics-edx
7.	http://nptel.ac.in/courses/112104121/6

Thermal Engineering

Course Code:	**ME1104-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the basic concepts and laws of thermal engineering.
2.	Apply the basic concepts for analysing the different thermodynamic systems.
3.	Understand the concept of pure substance with help of P-V, T-V and P-T diagrams to determine the thermodynamic properties.
4.	Understand and analyse the different power producing cycles along with the effect of operating variables on the efficiencies.
5	Understand and analyse power absorbing thermodynamic devices like air compressor, refrigerator and air-conditioning system

UNIT-I

Basic concepts:	**06 Hours**

Basic concepts: Macroscopic and Microscopic approach, Basic definitions - thermodynamic system, state, process, cycle, intensive and extensive properties, thermodynamic equilibrium, quasi-static process, path and point function Reversible and irreversible processes, Zeroth Law.

Work and heat transfer: Thermodynamic definition of work, Displacement work, pdv work for various processes, Heat transfer.	
First law of thermodynamics	**09 Hours**
First law of thermodynamics: First Law for a non-flow system undergoing a cyclic and non-cyclic process, Energy and enthalpy (numerical), PMM1, numerical, Steady flow energy Equation (SFEE) for different devices (numerical). Second law of thermodynamics and Entropy: Need for second law, cyclic heat engines, reversed heat engines, Kelvin-Planck and Clausius statements (numerical), PMM2, Carnot cycle, Carnot theorem, concept of entropy.	
UNIT-II	
Pure Substance:	**06 Hours**
Pure Substance: Concept of a pure substance. Physics of phase-change processes. The P-v, T-v, and P-T property diagrams of pure substances. Procedures for determining thermodynamic properties	
Vapor power cycle:	**04 Hours**
Vapor power cycle: Simple Rankine cycle, effect of operating parameters on Rankine cycle (numerical), Reheat Rankine cycle, Regenerative cycles (only theory)	
Gas power cycles:	**05 Hours**
Gas power cycles: Air standard cycle-Otto, Diesel dual cycle, Air standard efficiency and comparison - (numerical). Gas turbine cycles: Simple Brayton cycle (numerical).	
UNIT-III	
Refrigeration cycles	**05 Hours**
Refrigeration cycles: Bell-Coleman cycle (only derivation), vapour compression refrigeration cycle (numerical). Properties of refrigerants.	
Psychrometry:	**05 Hours**
Psychrometry Basic definitions, properties of atmospheric air (numerical), psychometric chart, Representation of various processes – heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream; sensible cooling load and latent cooling load, Numerical problems by using psychrometric chart on psychometric processes only.	
Course Outcomes: At the end of the course student will be able to	

1.	Explain the basic concepts of thermodynamics and the concept of energy and define its various forms. Analyse the concept of thermodynamic work. Deduce expressions for displacement work and heat transfer for various quasi-static processes through p-V diagrams. Solve numerical involving heat and work for thermodynamic applications.
2.	Apply the first law of thermodynamics to determine heat and work transfer to and from the system. Solve energy balance problems for thermodynamic devices. Apply second law of thermodynamics to check the direction of energy flow. Determine the expressions for the thermal efficiencies and coefficients of performance for reversible heat engines, heat pumps, and refrigerators. Illustrate the concept of entropy and principle of increase in entropy.
3.	Illustrate the P-v, T-v, and P-T property diagrams of pure substances and solve numerical problems. Analyse vapor power cycle using the knowledge of heat and work interactions.

	Describe the techniques to increase the thermal efficiency of a steam power plant and solve related problems.
4.	Differentiate the power generation cycles and compare their performance based on operating parameters. Describe the suitable techniques to improve the performance of gas turbines. Solve problems on air standard cycles and gas power cycles. Analyse the factors which affects the performance of IC engines
5.	Differentiate gas refrigeration and vapour compression cycle and explain the effect of irreversibility on the performance of refrigeration cycle. Determine the quality of air by using psychrometric principles and chart

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1104-1.1	**3**	**1**	**-**	**-**	**-**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**-**	**2**	**-**
ME1104-1.2	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
ME1104-1.3	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
ME1104-1.4	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
ME1104-1.5	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Engineering Thermodynamics, P.K.Nag, Tata McGraw-Hill Education, 2006
2.	Engineering Thermodynamics, C.P.Gupta, Rajendra Prakash, , Nemi Chand & Bros,2009

Mechatronics

Course Code:	**ME2104-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand basic mechatronic systems, mechanical components, actuators, sensors and with controllers of mechatronic systems. Gaining knowledge of pneumatic elements like valves, FRL units and pneumatic actuators
2.	To familiarize with the various types mechanical switches, Solid state switches, drives and controls, characteristics and models of various electromechanical actuators. Provide sound understanding of signal conversion i.e. ADC to DAC and vice versa, amplifiers, comparators and basic architecture of PLC systems.
3.	Understand architecture of 8085 microprocessors, micro controller, logic gates, and flip-flops
4.	Analyse, design and develop the hydraulics and pneumatics circuits for industrial applications.
5	Analyse, design and develop the Electro pneumatic, electrohydraulic and PLC based control systems for automation task

UNIT-I

Introduction:	**07 Hours**

Introduction to Mechatronic systems, Measurement systems, control systems, microprocessor-based controllers, Mechatronics approach. Examples and discussions on typical mechatronic systems. Review of Transducers and Sensors: Introduction to Transducers and sensors, their classification, light sensors, proximity sensors and Hall-effect sensor, encoders, selection of sensors.

Pneumatic Systems:	**09 Hours**

Introduction, Basic structure of pneumatic systems, filter, lubricator, regulator, Valves Classification, Pressure control valve, Flow control valve, Direction control valve. Types of cylinders, air motors, air compressors, Symbols of Pneumatic elements, and application circuits

UNIT-II

Drives and controls:	**06 Hours**

Mechanical system: Anti Friction guide ways, timer belt and pulley, high speed precession bearings.

Electrical Actuation Systems:	**04 Hours**

Actuators and actuator system, classification, Mechanical switches, Solenoids, relays, solid-state switches, Motors- DC & AC motors, Stepper motors, servo motor

Signal conditioning:	**05 Hours**

Introduction to signal conditioning, Operational amplifier, Inverting, Non- inverting, Summing, Integration, Differential amplifier, protection, filtering, wheat stone bridge, Analog +Digital Converter & Digital- Analog Converter, Multiplexers, Data acquisition system

UNIT-III

Microprocessors:	**05 Hours**

Introduction to microprocessor, microprocessor based digital control, Basic elements of control system, 8085 A microprocessor architecture and terminology, Microcontrollers. Differences b/w microprocessor & micro controllers. Classification of micro controllers.

.

Programmable logic controller:	**04 Hours**

Introduction to PLC"s, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching &selection of a PLC. Logic gate using PLC

Course Outcomes: At the end of the course student will be able to

1.	Summarize significance of mechatronics, demonstrate different transducers, which are used in vital mechatronic applications. Describe different pneumatic components along with their functions
2.	Illustrate the operational characteristics of mechanical and electrical actuator systems. Describe the concept of Amplifiers, Filters, Analogue and digital signal, Converters (ADC, DAC) and DAQ for its industrial applications
3.	Utilize the knowledge of logic gates, microprocessor, microcontroller, and PLC. Develop PLC ladder programming for industrial applications.
4.	Design, simulate and develop pneumatic circuits for Industrial applications using these pneumatic components
5.	Analyse the design and developing the Electro pneumatic and PLC based control systems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2104-1.1	**3**	**1**	**1**		**1**	**-**	**-**	**-**	**3**	**1**	**-**	**2**	**3**	**1**	**2**
ME2104-1.2	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**3**	**1**	**2**
ME2104-1.3	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**	**3**	**1**	**2**
ME2104-1.4	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**2**	**3**	**1**	**2**
ME2104-1.5	**3**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**	**3**	**1**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Mechatronics “, W. Bolton, pearson education, third edition. 2013
2.	“Microprocessor Architecture, programming and applications with 8085.8085 R.S. Ganokar, Wiley Eastern.1987
3.	Introduction to Mechatronics”, K. K. Appukuttan,Oxford University press, 2007 edition
4	Pneumatic systems S. R Majumdar, Tata Mc.Graw-Hill, Publishing company,ltd. 1997

REFERENCE BOOKS:

1.	Mechatronics, Nitaigour Premchand Mahilik, Tata Mc.Graw-Hill, Publishing company, Ltd. 2003

2.	Pneumatics Basic level TP101, Peter Croser and Frank Ebel,Festo Didactic Publications. 2003
3.	Fundamentals of pneumatic control engineering, J.P. Hasebrink and R.Kobbler, Festo Didactic Publications. 1978
4.	A Textbook of Mechatronics, RK Raput, S.Chand Publishing

Design of Machine Elements

Course Code:	**ME3100-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1103-1,ME1102-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the concepts of design and various terms connected to design like static strength, fatigue strength, and failure theories.
2.	Understand the concepts of fatigue under different loading conditions, quantify how the Winkler-Bach theory can be used to analyse the distribution of stresses in crane hooks.
3.	Understand the design considerations of welded joints under different loading conditions, evaluate the parameters necessary to design different springs.
4.	Identify the factors to be considered while designing different brakes and clutches.
5.	Demonstrate the ability to develop designs for different gears, design the shafts for various loading conditions.

UNIT-I

Introduction: Meaning of design with special reference to machine design- Definition and understanding of several types of designs. Concept of design, Engineering Materials and their Mechanical properties. Selection of materials, General Design considerations: codes and Standards, Stress Analysis of simple components.	**07 Hours**
Design for Static Strength: Static Strength, Static loads and factor of safety; Theories of failure – Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory. Stress concentration, Determination of Stress concentration factor. Design of simple machines: Crane hook, closed rings and links. Design for Fatigue Strength: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors: size effect, surface effect, Stress concentration effects; Fluctuating stresses, Goodman, Modified Goodman and Soderberg's relationship; stresses due to combined loading, cumulative fatigue damage.	**09 Hours**

UNIT-II

Welded Joints – Types, Strength of butt and fillet welds, eccentrically loaded welded joints Numerical on welded joints.	**06 Hours**
Design of springs: Compression springs, stresses in coil springs of circular and non-circular cross sections, leaf springs – stresses in leaf springs; equalized stresses – energy stored in springs; torsion springs, Belleville springs	**05 Hours**
Clutches & Brakes: Design of multi plate clutches; design of cone clutch, design of double shoe block brakes, simple and differential band brakes, principle and condition for self-locking of brakes.	**04 Hours**

UNIT-III

Shafts: Torsion of shafts, design for strength and rigidity with steady loading, ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads.	**05 Hours**
Design of Gears: Lewis equation, design of a spur gear pair. Helical gears: parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, design of helical gear pair.	**04 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Understand the basic concepts involved in machine design and design simple machine components subjected to static loading conditions for different material properties.
2.	Design simple machine elements subjected to fatigue loading using Goodman and Soderberg design equations, design crane hooks for a given load, cross section using relevant design equations. .
3.	Design welded joints under axial and eccentric loading conditions, Determine the various spring parameters for a specific load, material property, deflection.
4.	Design plate and cone clutches for a given specification and examine the shoe and band brakes to compute the heat generated and check the possibility of self-locking.
5.	Design of shafts subjected to Bending, torsional and fatigue loads based on strength and rigidity criterion, Design a pair of spur and helical gears given the number of teeth or pitch circle diameter, pitch line velocity and center distances

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME3100-1.1	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME3100-1.2	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME3100-1.3	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME3100-1.4	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME3100-1.5	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition (26th May 2010).
2.	Shigley J.E. and Mischke C.R., "Mechanical Engg. Design", McGraw Hill International Edition, 8th Edition, 2010.

REFERENCE BOOKS:

1.	Machine Design: Robert L. Norton, Pearson Education Asia, 5th Edition (16th September, 2013).
2.	Design of Machine Elements: M.F.Spotts, T.E. Shoup, L.E. Hornberger, S.R. Jayram and C.V. Venkatesh, Pearson Education, 2006.
3.	Machine Design**:** Hall, Holowenko, Laughlin (Schaum's Outlines series). Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
4.	Norton R.L., "Machine Design" , Pearson Education Asia, 2012.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/112105125

Vocational Education Course

Course Code:	**ME1551-1**	**Course Type**	**VEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**26**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and processes.

1.	To demonstrate safety precautions to be adopted during welding operations
2.	To practice and learn edge preparation required to welding of steel joints
3.	To learn the skill of welding using manual arc welding and its characteristics
4.	To learn welding of steel plates using Metal inert gas welding
5.	To learn welding of steel plates using Tungsten inert gas welding

UNIT-I

Safety Practices

1. Locate WHMIS label and interpret the information displayed.
2. Locate an MSDS sheet for a product used in the workplace.
3. Determine what personal protective equipment and other precautions are required when handling welding.

Sample preparations

.1. Cutting

i. straight cutting

ii. bevel cutting

2. Gouging

i. gouge groove in flat plate

3. Edge preparation

i. Straight groove

ii. V groove

06 Hours

UNIT-II

Practice with Shielded Metal Arc Welding — **08 Hours**

1. Set-up welding equipment and selection of electrodes.

2. Arc Initiation with touch-retract method and Scratch initiation

3.Deposit stringer beads

3. Deposit weave beads

4. Demonstrate Welding of few common joints and shapes

Gas Metal Arc Welding — **06 Hours**

1. Setup GMAW equipment.

2. Adjust electrode wire guide and check flow meter. 3. Virtual Welding practices on fillet welds 4. Deposit fillet welds on mild steel.	
UNIT-III	
1. Setup GTAW equipment, strike and maintain arc. 2. Change electrode, collet and collet body. 3. Adjust and check flow meter. 4. Run beads on cold rolled steel plate.	**06 Hours**

Course Outcomes: At the end of the course student will be able to

1.	The ability to recognize situations requiring emergency action and to make appropriate decisions concerning first aid.
2.	Demonstrate the process required for edge preparation
3.	Demonstrate arc initiation and bead welding using SMAW
4.	Demonstrate welding of steel joints using MIG welding
5.	Demonstrate welding of steel joints using TIG welding

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1551-1.1	1	-	-	-	-	1	-	1	-	1	-	-	-	-	-
ME1551-1.2	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1551-1.3	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1551-1.4	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-
ME1551-1.5	1	-	-	-	-	-	-	1	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Stena, S. *Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics - Includes Techniques You Can Use for Home and Automotive Repair, Metal Fabrication Projects, Sculpture, and More*. Quarry Books, 2014. https://books.google.co.in/books?id=lSWaAgAAQBAJ.

REFERENCE BOOKS:

1. Welding handbook by American Welding Society, 9th edition, Volumes 1 to 5.

2. Welding Handbook, American Welding Society, Section-II: Gas Arc and Resistance

Professional Core Courses (Lab)

CNC LAB

Course Code:	ME2601-1	Course Type:	PCC Lab
Teaching Hours/Week (L: T: P: S):	0:0:2:0	Credits:	01

Total Teaching Hours:	26	CIE + SEE Marks:	50+50
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

This Course will enable students to

1. Understand the manual part programming using ISO codes.
2. Write manual part programming for producing simple parts in a CNC turning center.
3. Write manual part programming for producing simple parts in a CNC vertical machining center.

List of Experiments

	Unit -1
1	Writing manual part programming using ISO codes for machining of simple machine parts involving facing, plain turning, taper turning, multiple turning, drilling and combined operations in CNC turning machine and verify the execution of program in SeeNC Turn simulation application. (6 Exercises)
2	Use the simulated program in CNC turning center and perform facing and plain turning operations.
	Unit -2
3	Writing manual part programming using ISO codes for machining of simple machine parts in CNC milling machine. Program involves grooving, slab and pocket milling, drilling and combined operations and verify the execution of program in SeeNC mill simulation application. (6 exercises)
4	Use the simulated program in CNC vertical machining center and perform slab milling and drilling operations.

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate the simulation of the tool path for the given part by using Numerical Control (NC) codes for CNC turning. Demonstrate the use of machining cycles and subprograms for repetitive tool path applications in CNC turning machine.
2.	Demonstrate the simulation of the tool path for the given part by using Numerical Control (NC) codes for CNC milling. Demonstrate the use of machining cycles and subprograms for repetitive tool path applications in CNC Vertical machining center.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2601-1.1	**1**	**2**	**1**	**-**	**3**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**3**
ME2601-1.2	**2**	**2**	**1**	**-**	**3**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Computer aided design and manufacturing‖ Groover Mikell P. and Zimmers Emory W Prentice Hall of India , New Delhi .(2003).
2.	―‘Manufacturing Automation Metal Cutting Mechanics, Machine Tool Vibrations, CNC Design‖, Yusuf, Cambridge University Press

Manufacturing & Machine Graphics & Drawing

Course Code:	ME2602-1	Course Type	PCC

Teaching Hours/Week (L: T: P: S)	**0:0:2:0***	**Credits**	**01**
Total Teaching Hours	**30**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1002-1**		

*** Self practice**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To understand the standards and symbols of Machine Drawing & Graphics
2.	To learn the Geometric Dimensioning & Tolerancing of manufacturing drawings
3.	To apply the standard principles of drawing pertain to various manufacturing processes
4.	To read the manufacturing drawings & draft the drawings associated with manufacturing operations.

UNIT-I

Engineering graphical projections for Mechanical Components	**06 Hours**

Introduction to Engineering Drawing, Geometrical Constructions, Plane Curves, Planes of Projections, Projections of Straight Lines, Inclined Lines, Planes and Solids, Sections of Solids, Developments of Surfaces, Orthographic Views, Isometric Projections, Perspective Projection.

CADD of Mechanical Components & BIM	**06 Hours**

Introduction to Computer Aided Design and Drafting, Introduction to AutoCAD, Editing Commands, Draw Commands, Advanced Commands, Dimensioning Commands, 3D Modelling Commands

Introduction to Building Information Modeling, BIM Categorization, Levels of BIM, BIM Implementation Departments, BIM Process, BIM Demo.

UNIT-II

Geometric Dimensioning & Tolerancing (GD&T) and Symbols & Standards	**06Hours**

Introduction to Geometric Dimensioning & Tolerancing (GD&T), Necessity of GD&T, Reference Frame and other Types of Frames, Understandings of Geometric & Dimensional Characteristics, Constraints & Symbols, Symbol of Surface Texture for Machining and other fabrication process

Different Types of Drawings & Layouts, Limits, Fits and Tolerance, Case Study related to GDT, Introduction to Welding Symbols & Standards, Welded, Brazed and Soldered Joints, Case Studies related to Drawings and Layouts.

Drawings of Temporary Joints, Fasteners and Dies	**06Hours**

Introduction of various elements required for Fasteners, Symbolic representation – Fastener (Bolts, Nuts, Screws), Drawings of Keys, Bearings, Universal Joints, Couplings, Case Study related to Temporary Joint Components.

Standards & symbols followed in the Mold Design for Casting Process, Drawing for Metal Forging process, Drawing for Sheet Rolling process, Case Study related to drawings of Casting, Forging and Forming process..

UNIT-III

Manufacturing Drawings of Process Equipment & Piping	**06 Hours**

Pressure Vessel, symbols and standards, Layout drawings, Production and Assembly drawings, Drafting Nozzles and heads, Welding details, vessel support systems, Materials and design consideration, Drafting a detailed drawing of few pressure vessels.

Heat Exchangers, Tube bundle and shell assembly drawing, Materials, Codes and standards, and Detailed drawing of Heat exchangers

Over view of Industrial valves, Valve Body, Valve Trim and Valve Bonnet diagrams and detailed drawings of Industrial valves, Material specification, standards, Symbols and codes for the drawings of Industrial valves

Industrial Piping, Pipe fittings, supports, codes and specifications, Fabrication and Installation Drawings

Course Outcomes: At the end of the course student will be able to

1.	Remember the standards and symbols pertaining to engineering drafting
2.	Understand any drawing irrespective of the manufacturing processes
3.	Apply the concepts to draw the part, production and Assembly drawings
4	Analyze the drawings of complicated structures and do the needed execution
5	Can design and provide drawings for any Mechanical/ Manufacturing Engineering applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2602-1.1	**3**				**3**								**3**		**3**
ME2602-1.2	**3**				**3**								**3**		**3**
ME2602-1.3		**3**	**3**										**3**		**3**
ME2602-1.4		**3**	**3**		**3**		**2**						**3**	**2**	**3**
ME2602-1.5		**3**	**3**		**3**		**2**						**3**	**2**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	"Textbook of Machine Drawing" by John K C
2.	"Textbook of Computer Aided Machine Drawing" by Murthy
3	"A textbook of Machine Drawing" by Gill P S

REFERENCE BOOKS:

1.	"Machine Drawing" by N D Bhatt
2.	Machine Drawing by Gopala Krishnan

3	Pipe Drafting and Design by Rhea and Perisher
4	Mastering AutoCAD 2019 and AutoCAD LT 2019- George Omura
E Books / MOOCs/ NPTEL	
1	https://www.amazon.in/Textbook-Machine-Drawing-R-K-Dhawan-ebook/dp/B00QUYKX34
2	https://eeedocs.files.wordpress.com/2014/02/machinedrawing.pdf

DYNAMICS LAB

Course Code: PCC (Lab)	**ME2603-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**26**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1103-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

This Course will enable students to

1.	Recall the difference between kinetics and dynamics through experiments.
2.	Visualize the stresses developed in an object through photo elasticity experiments and pressure distribution across and along the Journal bearing

UNIT-I

Free vibration experiments

1. Determination of time period and acceleration due to gravity using simple pendulum
2. Determination of time period, radius of gyration and acceleration due to gravity of Kater’s reversible pendulum
3. Determination of time period, radius of gyration and acceleration due to gravity of compound pendulums- circular, elliptical, rectangular, triangular, square plates
4. Determination of center of percussion of compound pendulums
5. Determination of time period/natural frequency of vibration of spring mass combination systems- series, parallel, parallel-series
6. Determination of time period/natural frequency of vibration of an equivalent spring-mass system
7. Determination of radius of gyration of a given body using bifilar/trifilar suspension
8. Measurement of Natural Frequency and Modal Shape of Simply Supported Beam Structure by the Method of Hammer Impact
9. Measurement of Natural Frequency and Modal Shape of Cantilever Beam Structure by the Method of Hammer Impact
10. Measurement of Natural Frequency and Modal Shape of Disc Structure by the Method of Hammer Impact
11. Determination of Damping Ratio (half –power bandwidth method and Attenuation method).
12. Passive Vibration Isolation.
13. Vibration with Single Absorber.
14. Vibration with Double Absorber.

UNIT-II

15. Verification of Dunkerley’s relationship
16. Static and dynamic balancing of rotating masses
17. Determination of time period/natural frequency of vibration of a single rotor and two rotor system

18. Natural Frequency and Modal Shape of Two or Three Degree of Freedom String
19. Natural Frequency and Modal Shape of Multi Degree of Freedom String
20. Study of damped torsional oscillation system
21. Determination of critical speed of a shaft
22. Study of pressure distribution in a journal bearing apparatus.

UNIT-III (Demonstration only)

23. Determination of damping ratio, damping coefficient, undamped and damped natural frequency of a single degree freedom system for forced vibration and plot the magnification factor vs the frequency ratio.
24. Determination of fringe constant of photo elastic materials using
    a) Circular disc subjected to diametric compression
    b) Pure bending specimen (four-point bending).

Course Outcomes: At the end of the course student will be able to

1.	Conduct simple experiments regarding free vibration involving linear motion and determine time period, natural frequency, center of percussion, radius of gyration and acceleration due to gravity.
2.	Conduct torsional vibration experiments, and verify the effect of damping on natural frequency and time period and determine the damping ratio and logarithmic decrement. Conduct forced vibration experiments and determine critical speed of the shaft. Determine pressure distribution in a journal bearing.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
ME2603-1.1	2	3	1	2	-	1	1	-	3	1	-	1	1	3	-
ME2603-1.2	2	3	1	2	1	1	1	-	3	1	-	1	1	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4PthP Edition, 2003.
2. Mechanical Vibrations, V. P. Singh, DhanpatRai& Company Pvt. Ltd., 3PrdP Edition, 2006.
3. Mechanical Vibrations, G. K. Groover, Nem Chand and Bros., Rookee, India, Seventh Edition, 2003.
4. Mechanical Vibrations, William Seto, Schaum's Outline Series, McGraw Hill, 1983

REFERENCE BOOKS:

1. Mechanical Vibrations, S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
2. Theory and Practice of Mechanical Vibrations, J. S. Rao and K. Gupta, New Age International Publications, New Delhi, 2001.
3. Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw Hill, Special Indian Edition, 2007.
4. Mechanical Vibrations, J. B. K. Das and Srinivasa Murthy, Sapna Book House, Fifth Edition, 2009.
5. Theory of Vibration with Applications, W. T. Thomson and Marie Dillon Dahleh, Pearson Education, 5PthP Edition, 2007.
6. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4PthP Edition, 2003.
7. Mechanical Vibrations, V. P. Singh, DhanpatRai& Company Pvt. Ltd., 3PrdP Edition, 2006

E RESOURCES:

1.	https://mdmv-nitk.vlabs.ac.in/List%20of%20experiments.html (Machine Dynamics and Mechanical Vibrations Lab Virtual lab link)
2.	https://nptel.ac.in/courses/112106068 (NPTEL Course link by K. Ramesh, on Experimental Stress Analysis, IIT Madras)

ENERGY CONVERSION ENGINEERING LAB

Course Code:	**ME2604-1**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Find flash and fire point of lubricating oil using Abel Pensky and Pensky Martins apparatus.
2.	Find caloric value of solid, liquid and gaseous fuels and select the fuel for combustion.
3.	Find viscosity of lubricating oils using Redwood, Saybolt viscometers and study. Find variation of viscosity with temperature, select proper lubricating oil for various applications
4.	Draw valve timing/port opening diagram of four stroke and two stroke I. C engine
5.	Find the performance parameters of I.C engine. Method of energy generation in fuel cell and solar panel.

List of Experiments

	Unit -1
1	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.
2	Determination of Caloric value of solid, liquid and gaseous fuels.
3	Determination of Viscosity of lubricating oil using Redwoods, Saybolts and Torsion Viscometers.
4	Valve, Timing/port opening diagram of an I. C. engine (4 stroke/2 stroke).
	Unit -2
1	**Performance Tests** on I. C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for: (a) Four stroke Diesel Engine. (b) Four stroke petrol Engine. I Multi cylinder Diesel/Petrol Engine (Morse test) (d) Two stroke Petrol Engine. **Demonstration experiments:** (a) Understanding the concept of Energy generation in fuel cell. (b) Determining the solar panel efficiency.

Course Outcomes: At the end of the course student will be able to

1.	Conduct performance tests on SI and CI engines and calculate IP, BP, Thermal efficiencies, SFC,FP and prepare heat balance sheets.
2.	Find flash and fire points, viscosity of lubricating oils. Draw valve timing/port opening diagrams for four stroke and two stroke I.C engines. Determine calorific value of fuels.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3

ME2604-1.1	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**2**	**-**
ME2604-1.2	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**2**	**-**

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Computer aided design and manufacturing‖ Groover Mikell P. and Zimmers Emory W Prentice Hall of India , New Delhi .(2003).
2.	―'Manufacturing Automation Metal Cutting Mechanics, Machine Tool Vibrations, CNC Design‖, Yusuf, Cambridge University Press

METROLOGY & MEASUREMENTS LABORATORY

Course Code:	**ME2605-1**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**ME1101-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Expertise on linear measuring instruments such as Vernier instruments, Gear tooth vernier caliper, screw thread micrometers etc
2.	For a given measurement problem student will be able to identify to choose between precision measuring instruments and comparators such as profile projectors, optical measuring devices like tool makers microscopes, sine bars etc with required accuracy
3.	Obtain numerical solutions & calibrate a given measuring instrument with required accuracy by referring to standard values given by national physical laboratory for pressure temperature and strain Instruments

List of Experiments

1.	Measurements using Optical Projector / Toolmaker Microscope.
2.	Measurements of angle using Sine Center / Sine bar / bevel protractor
3.	Measurements of alignment using Autocollimator / roller set
4.	Measurements of cutting tool forces using a. Lathe tool Dynamometer b. Drill tool Dynamometer
5.	Measurements of Screw Thread Parameters using two wire or three wire method
6.	Measurements of Surface roughness. Using Tally surf/mechanical Comparator
7.	Measurements of gear tooth profile using gear tooth vernier / gear tooth micrometer.
8.	Calibration of micrometer using slip gauges
9.	Measurement using Optical Flats
10.	Calibration of Pressure Gauge
11.	Calibration of Thermocouple
12.	Calibration of LVDT
13.	Calibration of Load cell
14.	Determination of modulus of elasticity of a mild steel specimen using strain gauges
15.	Measurement of Solar Radiation using pyranometer & Sunshine recorder.
16.	Weather monitoring using weather station
17.	Measurement of air flow using air flow meter.
18.	Measurement of illuminances using Lux meter.

19.	Measurement of Electrical parameters using power clamp meters.
20.	Air Quality Index Monitoring & Measurement using Digital Particulate measuring device

Course Outcomes: At the end of the course student will be able to

1.	Choose and use mechanical and optical instruments with required accuracy for length and angle measurements of engineering parts.
2.	Calibrate a measuring system involving transducers for force, strain and temperature measurement

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2605-1.1	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**2**	**1**	**1**	**2**	**3**	**1**
ME2605-1.2	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**2**	**1**	**1**	**2**	**3**	**1**

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Mechanical measurements" by Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2.	Engineering Metrology" by R.K.Jain, Khanna Publishers.
3.	"Engineering Metrology" by I.C.Gupta, Dhanpat Rai Publications.
4.	"Measurement Systems Applications and Design" by Ernest O, Doblin, McGRAW Hill Book Co.
5	"Mechanical Measurements" by Thomas G Beckwith, Prentice-Hall, Pearson Education Limited.

E Resources

1.	NMAMIT Mechanical you tube channel.
2.	https://www.youtube.com/watch?v=Axx2qVsfBfA.
3.	https://www.youtube.com/watch?v=eUD_heqzmZY.
4	https://www.youtube.com/watch?v=C1wMIZzqmRU.
5	https://www.youtube.com/watch?v=R9JXOBwyEFA.
6	https://www.youtube.com/watch?v=C1wMIZzqmRU.

Professional Elective Courses (Design Stream)

Introduction to Piping Engineering

Course Code:	**ME1201-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To know the fundamentals of piping and pipe components.
2.	Study the types and purpose of different valves
3.	To get an understanding of cylinders and pipe thickness calculation.
4.	To get the thorough understanding of drawing associated with piping.
5	Classify different loads acting on pipe

UNIT-I

Scope of piping engineering, major phases in life cycle of a chemical process, Introduction to Piping, Fundamentals of piping, Classification of pipe, Pipe Manufacturing Methods, Pipe Sizes, Pipe Schedule & Pipe Representation.Codes and standards. Types of pipes. Material selection for pipe, pipe size, wall thickness.	**08 Hours**
Piping Components, Piping Fittings, Types of Flanges, Types of Valves, Speciality Items. Functions of valves.	**08 Hours**

UNIT-II

Thick and thin cylinders. Hoop stress, pipe thickness calculations. Piping arrangements, pipe rack layout, types of racks, width calculation.	**08 Hours**
Basics of piping and equipment layout, piping symbols, plans and isometrics. General Arrangement Drawing, Process and Instrumentation Drawing. Classification of tanks.	**08Hours**

UNIT-III

Pipe under stress, classification of loads and failures. Theories of failure. Methods of flexibility analysis, pipe supports.	**08 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Understand fundamentals of piping and do the pipe representation
2.	Identify different components of piping system and working of valves.
3.	Understand the different piping arrangements and perform thickness calculations.
4.	Understand and draw different types of piping layouts.
5.	Analyze the different loads acting on the pipe.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1201-1.1	-	1	3	2	1	2	1	1	1	1	1	2	1	2	-
ME1201-1.2	3	3	-	-	-	2	-	1	1	2	-	2	2	2	-
ME1201-1.3	2	3	-	-	-	-	-	-	1	-	3	-	-	1	-
ME1201-1.4	2	2	-	-	-	-	-	-	1	3	-	-	-	1	-
ME1201-1.5	3	3	2	2	2	2	-	-	1	3	-	1	-	1	-

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	Mohinder L Nayyar "Piping Hand book"
REFERENCE BOOKS:	
1.	Henry H. Bender, "Pressure Vessels, Design Hand Book", CBS Publishers and Distributors, 1987.
2.	Stanley, M. Wales, "Chemical Process Equipment, Selection and Design. Butterworth's series in Chemical Engineering", 1988.

Mechanical Vibrations

Course Code:	**ME2203-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1202-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand about single degree of freedom systems, modelling and determination of its parameters.
2.	Know about damping, types of damping and its influence on the system response.
3.	Understand the response of mechanical systems subjected to harmonic excitation and about vibration measurement.
4.	Understand about two degree of freedom systems, to find its natural frequencies and mode shapes.
5	Understand about multi degree freedom system problems.

UNIT-I	
Introduction:	**08 Hours**
Types of Vibrations, Simple Harmonic Motion, and Principle of superposition applied to simple harmonic motions, Beats and simple problems. Undamped Free Vibrations: Single Degree of Freedom systems, Natural frequency of undamped free vibrations, Parallel and series combination of springs-equivalent stiffness, effect of mass of spring on natural frequency, Problems.	
Damped Free Vibrations:	**09 Hours**
Single degree of freedom systems, Different types of damping, Concept of critical damping and its importance, Study of response of viscous damped systems for cases of under-damping, critical-damping and over-damping, Logarithmic Decrement, Problems	
UNIT-II	
Forced Vibrations:	**06 Hours**
Single Degree of Freedom Systems, Forced Vibration of spring-mass-damper system, transient and steady state solution, Reciprocating and rotating unbalance, Force transmitted to the base due to harmonic excitation-Force Transmissibility, Vibrations due to support motion-Motion Transmissibility.	
Vibration Measurement:	**04 Hours**
Vibrometers and Accelerometers, Numerical problems.	
	04 Hours
Analysis of two Degrees of Freedom Systems: Introduction, principal modes of vibration, masses on tightly stretched strings, double pendulum, problems	
UNIT-III	
Numerical methods	**05 Hours**

for multi degree freedom systems: Introduction, Influence coefficients, Maxwell's reciprocal theorem.

04 Hours

Method of Matrix Iteration, Stodola's Method, and Holzer's method

Course Outcomes: At the end of the course student will be able to

1.	Calculate the natural frequency of a single degree of freedom system using Newton's second law of motion and energy method and apply mathematical techniques to model systems.
2.	Distinguish between different types of mechanical systems depending on the amount of viscous damping present in the system and determine its characteristics. Determine parameters of underdamped systems using logarithmic decrement
3.	Determine the response and characteristics of mechanical systems subjected to harmonic excitation using mathematical modeling. Discuss the use of vibration measurement using vibrometers and accelerometers
4.	Calculate the natural frequencies and mode shapes of two degrees of freedom systems. Determine the amplitude of vibration using vibration measurement instruments
5.	Calculate natural frequencies and mode shapes of multi degree freedom systems using Stodola, Matrix Iteration, and Holzer's method

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2203-1.1	**1**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME2203-1.2	**1**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME2203-1.3	**1**	**2**	**3**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME2203-1.4	**1**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME2203-1.5	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4PthP Edition, 2003.
2.	Mechanical Vibrations, V. P. Singh, DhanpatRai & Company Pvt. Ltd., 3PrdP Edition, 2006.
3.	Mechanical Vibrations, G. K. Groover, Nem Chand and Bros., Rookee, India, Seventh Edition, 2003
4	Mechanical Vibrations, William Seto, Schaum's Outline Series, McGraw Hill, 1983

REFERENCE BOOKS:

1.	Mechanical Vibrations, S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
2.	Theory and Practice of Mechanical Vibrations, J. S. Rao and K. Gupta, New Age International Publications, New Delhi, 2001.
3.	Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw Hill, Special Indian Edition, 2007.
4.	Mechanical Vibrations, J. B. K. Das and Srinivasa Murthy, Sapna Book House, Fifth Edition, 2009.
5	Theory of Vibration with Applications, W. T. Thomson and Marie Dillon Dahleh, Pearson Education, 5PthP Edition, 2007

E Books / MOOCs/ NPTEL

1.	1.http://nptel.ac.in/courses/112103111/
2.	http://nptel.ac.in/courses/112103112/
3.	https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics- fall-2011/mechanical-vibration

Design of Aircraft Structures

Course Code:	**ME2201-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1301-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Discuss aircraft design process, loads and structures.
2.	Discuss aircraft material properties, static and fatigue failures.
3.	Explain and solve problems related to bars, beams, shafts and columns.
4.	Explain and solve problems related to box beams and buckling of thin sheets.
5	Discuss and solve problems related to Structural Joints, Advanced materials, Vibrations and Flutter.

UNIT-I

Chapter-1-Overview of the Aircraft Design Process
Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies,
Airworthiness- Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design covers-Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements.

Chapter-2 -Aircraft Loads

Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads.

Chapter 3- Aircraft Structures Description
Types of Structural members of Fuselage and wing section and empennage Ribs, Spars, Frames, Stringers, Longeron, Splices, Types of structural joints, Type of Loads on structural joints.

09 Hours

Chapter 4-Aircraft Materials and properties Introduction, Basic construction, Material forms-Metallic materials and forms. Alloy designations. Mechanical Properties- strength, static, stress strain curves, Fatigue properties, crack growth.

Chapter 5- Static and Fatigue Failures
Principal stresses, principal strains, Mohr's circle for stress and strain, Fatigue Failures, Fatigue theory, Introduction to Low cycle Fatigue, Stress Life and Strain Life Techniques, Mean stress effects, Multi-axial Effects, Thermomechanical Fatigue, Introduction to high cycle fatigue.

08 Hours

UNIT-II

Chapter 6-Theroy of bars ,Beams, Shafts and Columns — **08 Hours**
Axially loaded structures, Methods of analysis-Method of joints and Method of sections, Space truss.
Beam theory, Section properties, Deflection of beams, Symmetric and Unsymmetric bending, Plastic bending, Shear stress in beams, Shear center, Torsion of Solid Sections, Torsion of Thin walled-open and closed sections, Columns Theory-Euler equation, Effective column length, Plasticity effects, Thin walled columns-Crippling, Beam columns.

Chapter 7- Box Beams Box Beams- Introduction, Shear flow due to shear, Shear flow due to torsion-Bredt Baths, Single and Multicell Boxes. Chapter -8 Buckling of Thin Sheets Buckling of thin sheets, Buckling of flat plate in compression and shear, Buckling of curved plates in compression and shear, buckling of stiffened panels-post buckling, effective width, Concept of diagonal tension, buckling under combined loads.	**08Hours**
UNIT-III	
Chapter 9- Aircraft Structural Joints Introduction, Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Welded joints, Bonded joints, Lug Analysis, Tension Fitting and clips **Chapter10- Advanced materials, Vibrations and Flutter** Introduction to Comp Materials, Matrices, Fibers, Forms, Characteristics of composite materials, Importance of Study of Vibration and Flutter.	**07 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Discuss aircraft design process, loads and structures.
2.	Discuss aircraft material properties, static and fatigue failures.
3.	Explain and solve problems related to bars, beams, shafts and columns.
4.	Explain and solve problems related to box beams and buckling of thin sheets.
5.	Discuss and solve problems related to Structural Joints, Advanced materials, Vibrations and Flutter.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2201-1.1	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**	**-**
ME2201-1.2	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**	**-**
ME2201-1.3	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**
ME2201-1.4	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**
ME2201-1.5	**2**	**2**	**3**	**-**	**-**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA Education, series,6th Edition

REFERENCE BOOKS:

1.	Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition
2.	Aircraft Structures for engineering students by T. H. G. Megson, Butterworth-Heinemann,Third Edition

Material Selection for Engineering Design

Course Code:	**ME2202-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1007-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand design process and properties of engineering materials
2.	Apply the knowledge of material selection using material property charts and to gain knowledge about material selection under fatigue, corrosion &fracture.
3.	Understand wear mechanism and knowledge of the design of plastics and ceramics.
4.	Apply process selection procedure and to gain the knowledge in process selection through case studies.
5	Understand design for machining and joining process and to know the basics of hybrids.

UNIT-I

The design process: types of design, design tools, conceptual and configuration design of products, analysis of technical systems, case study. Families of engineering materials and mechanical properties: Ferrous and Non-ferrous metals and Alloys, Ceramics, Polymers, Composites. The causes of failure in service.	**07 Hours**
Effects of composition, structure and processing on material properties; Material property charts, Basis of material selection. Evolution of microstructure change in steel products. Design for fracture toughness, fatigue resistance, corrosion resistance, and high temperature applications. Case studies in materials selection	**09 Hours**

UNIT-II

Design for Wear resistance, wear mechanism, and wear design; case studies for design with plastics, ceramics and composites.	**08 Hours**
Manufacturing aspects of design: Processes and process selection, selection charts, taxonomy of the process kingdom; case studies in process selection; case studies: design for casting, effect of casting on properties, design for deformation processes**.**	**08Hours**

UNIT-III

Designing for machining and joining, design for ceramic and plastic processing; case studies with multiple constraints and conflicting objective, Introduction to hybrids and types**.**	**08 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Understand the basics of design processes and mechanical properties of engineering materials.
2.	Analyze selection of materials using material property charts through case studies.
3.	Understand wear mechanisms and knowledge of design for plastics, composites and ceramics.
4.	Analyze the selection of processes using charts.
5.	Review the study of machining and joining processes and introduction to hybrid materials.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2202-1.1	**-**	**1**	**-**		**1**	**2**	**2**	**-**	**-**	**1**	**1**	**-**	**3**	**1**	**3**
ME2202-1.2	**2**	**1**	**2**	**1**	**-**	**2**	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**2**	**3**
ME2202-1.3	**2**	**-**	**2**	**2**	**-**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**3**	**2**	**3**
ME2202-1.4	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**3**
ME2202-1.5	**2**	**-**	**1**	**2**	**1**	**2**	**2**	**-**	**1**	**-**	**1**	**2**	**2**	**1**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Material selection in Mechanical Design, Michael F. Ashby, Elsevier (3rd edition 2005).
REFERENCE BOOKS:	
1.	Henry H. ASM Hand book of Materials Selection and Deign, 1996

INDUSTRIAL TRIBOLOGY

Course Code:	**ME3201-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1005-1,ME1102-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Explain about the types of lubricants, their properties and method to determine the properties. To obtain the equation of flow through pipe and through parallel plates.
2.	To recollect the phenomenon of friction and the theories of friction. To discuss the effect of friction on component life.
3.	To give details about the selection of materials and surface treatment methods such as heat treatment, carburizing, nitriding, and surface coating techniques such as hard facing and vapour deposition method that improve the wear resistance of the surface.
4.	Explain the mechanism of pressure development in oil film. To derive the Reynolds equation and discuss its importance.
5.	To provide details about hydrostatic lubrication. To derive the equations used to determine the load carrying capacity, oil flow and power loss in hydrostatic step bearing.

UNIT-I

Introduction	**08 Hours**
Content: Introduction to Tribology, lubricants – Properties of lubricants, viscosity, Newton's Law of viscosity, Hagen-Poiseuille law, Flow between parallel stationary planes, viscosity measuring apparatus, effect of temperature and pressure on viscosity.	
Hydrodynamic lubrication	**08 Hours**
Content: Mechanism of pressure development Tower's Experiments Reynold's equation in two dimensions, working of Partial and full journal Bearing, Load carrying capacity, Friction forces and power loss in lightly loaded bearing.	

UNIT-II

Friction	**05 Hours**
Content: introduction, laws of friction, types of friction – sliding, rolling, friction of metals, friction of ceramics, polymers, stick-slip, topography of engineering surfaces, contact between surfaces.	
Wear	**05 Hours**
Content: Introduction, types of wear mechanisms – adhesive, abrasive, fatigue, impact, corrosive wear, wear of materials – metals and alloys, ceramics, polymers, wear measurement, Effect of speed, temperature and pressure, Commonly used bearing materials, properties of typical bearing materials.	

UNIT-III

Slider/pad bearing with fixed and pivoted shoe	**09 Hours**
Content: Pressure distribution, Load carrying capacity, Coefficient of friction, frictional resistance in a fixed shoe and pivoted shoe bearing, influence of end leakage, numerical problems, idealized full journal bearings, Partial journal bearing, Numerical problems.	
Hydrostatic Lubrication	**05 Hours**

Content: introduction, Hydrostatic step bearing – load carrying capacity, oil flow, stiffness, and numerical problems.

Course Outcomes: At the end of the course student will be able to

1.	Recall the concepts related to the flow of fluids and illustrate the use of lubrication and lubricants.
2.	Interpret frictional behavior in metals and nonmetals.
3.	Discuss different types of wear and apply various surface treatment methods.
4.	Discuss the different types of lubrication and types of bearings, their design and performance.
5.	Derive analytical expressions related to the design and performance of hydrostatic bearings.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
ME3201-1.1	**2**	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
ME3201-1.2	**2**	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
ME3201-1.3	**2**	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
ME3201-1.4	**1**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**1**
ME3201-1.5	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Introduction to Tribology of Bearings – B.C. Majumdar, S. Chand & Company Ltd., New Delhi, 2008.
2.	Principles and Applications of Tribology – Bharat Bhushan, John Wiley and Sons Inc., 1999.
3.	Tribology in Industries – Sushil Kumar Srivastava, S. Chand & Co. Ltd., New Delhi, 2001.

REFERENCE BOOKS:

1.	Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E.I., Oxford Press Company.
2.	Engineering Tribology, Prasanta Sahoo, PHI Learing Pvt. Ltd., New Delhi.
3.	Fundamentals of Tribology, S.K. Basu, S.N. Sengupta and B.B. Ahuja, PHI Learing Pvt. Ltd., New Delhi

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/112102014

INTRODUCTION TO AIRCRAFT DESIGN

Course Code:	**ME1301-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Get an exposure to the Aerospace Industry and understand the Basics of Aircraft and Aircraft Structures.
2.	Understand basic principles of flight.
3.	Appreciate the basic mechanics of flight.
4.	Classify and appreciate the different aircraft design configurations, and aircraft systems
5.	Appreciate the importance of different aircraft systems and subsystems

UNIT-I	
Aircraft industry overview Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, , Prime contractors, Tier 1 Suppliers, Aerospace industry trends, Global and Indian Aircraft Scenario. Aircrafts Classification and Structure	**08 Hours**
Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Forces on the airplane, Control surfaces, Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Basic Principles of Flight Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, High lift devices(flaps and slats), Effect of flaps and slats on lift, drag and angle of attack. Significance of speed of Sound, Mach Numbers, Mach Waves, Mach Angles, Shock Waves, Sonic and Supersonic Flight and its effects.	**08 Hours**
UNIT-II	
Basics of Flight Mechanics Stability and Control: Meaning of stability, Definitions of static and dynamic stability, Types of static stability- Lateral, Longitudinal and Directional Stability, Maneuverability , Control Tabs, Landing, Gliding, Turning- Forces acting on a Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank.	**07 Hours**
Maneuvers: Aerobatics – Loop, spin, Inverted Maneuvers – inverted loop	**08 Hours**
UNIT-III	
Aircraft Systems Types of Aircraft Systems, Classification, Engine Control Systems, Types of engines- Turbo jet, Turbo fan and Turbo prop, Fuel systems, Hydraulic systems – open and closed loop hydraulic system. Landing gear systems, Ice and rain p r o t e c t i o n s y s t e m s and Air- Conditioning Systems, Brief overview electronics.	**09 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Summarize the importance of Aerospace and Airline Industry in design and Manufacturing sectors. Identify hardware components in Aircrafts Structures .
2.	Describe the basic principles of flight and Analyze the set-up and operations involved. Solve simple problems using principles of flight dynamics.
3.	Describe the basic mechanics of flight and flight dynamics.
4.	Classify the aircraft design configurations and aircraft systems
5.	Illustrate the various systems in macro-micro scaled architecture involved in Avionics and Explain the mechanical, electrical, hydraulic and thermal systems by applying knowledge of mathematics and physics.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1301-1.1	**1**	**-**	**-**	**1**	**-**	**3**	**3**	**2**	**1**	**2**	**-**	**3**	**-**	**-**	**3**
ME1301-1.2	**1**	**2**	**1**	**1**	**3**	**2**	**3**	**1**	**1**	**1**	**-**	**2**	**-**	**2**	**-**
ME1301-1.3	**1**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**-**
ME1301-1.4	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**-**	**2**	**1**	**1**	**-**
ME1301-1.5	**1**	**-**	**-**	**1**	**-**	**2**	**3**	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Flight without Formulae by A.C Kermode, Pearson Education,10th Edition.
2.	Mechanics of Flight by A.C Kermode, Pearson Education, 5thEdition.

REFERENCE BOOKS:

1.	Introduction to Flight by Dave Anderson

2.	Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian Moir, Allan Sea Bridge.
3.	Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition

ADVANCED STRENGTH OF MATERIALS

Course Code:	**ME2301-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1102-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the concept of stress and determine the stress components.
2.	Understand and determine the components of strains and the stress-strain relations.
3.	Carry out analysis of two-dimensional problems in Cartesian co-ordinates.
4.	Solve two-dimensional problems in polar co-ordinates.
5.	Understand the concepts of torsion and viscoelasticity.

UNIT-I

Introduction to Stress: Definition and notation for forces and stresses, body force, surface force, components of stresses, equations of equilibrium, specification of stress at a point- stress tensor, deviatorial and spherical stress tensors, Cauchy’s equations and principal stresses, stress invariants, boundary conditions, stress transformation, Octahedral stresses.	**08 Hours**
Introduction to Strain: Deformation, strain displacement relations, strain components, state of strain at a point, principal strains, strain invariants, strain transformation, compatibility equations, spherical and deviatorial strain tensors. General equations of Elasticity: Generalized Hooke's law in terms of engineering constants, formulation of elasticity problems.	**08 Hours**

UNIT-II

Two dimensional problems in Cartesian co-ordinates: Plane stress, plane strain, Airy's stress function, investigation of simple beam problems, bending of a narrow cantilever beam under end load, simply supported beam with uniformly distributed load.	**07 Hours**
Two dimensional problems in Polar co-ordinates: Basic relations in polar coordinates, Equilibrium equation and strain-displacement relations in polar coordinates, compatibility equation and biharmonic equation in polar coordinates, thick walled cylinder subjected to internal and external pressure, rotating disks of uniform thickness	**08 Hours**

UNIT-III

Torsion of Prismatic Bars: Introduction, Torsion of circular and elliptical cross section bars, Prandtl’s Membrane analogy, Torsion of thin-walled sections. Viscoelasticity: Linear viscoelastic behavior. Simple viscoelastic models-generalized models, linear differential operator equation.	**09 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Describe the concept of state of stress at a point and determine the components of stress on any given plane and principal stresses.

2.	Compute the state of strain in an arbitrary plane and principal strains and Co-relate the stress components with strain components using generalized Hooke's law.
3.	Analyze the two-dimensional problems in Cartesian co-ordinates by applying the concept of Airy's stress function and biharmonic equations.
4.	Analyze the stresses for two-dimensional problems on rotating disks in the polar coordinate system.
5.	Determine the shear flow and shear stress distribution in thin walled sections; Describe the generalized models used for modeling viscoelastic behavior.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2301-1.1	**2**	**3**	**1**	**2**	**-**	**1**	**1**	**-**	**3**	**1**	**-**	**1**	**3**	**1**	**-**
ME2301-1.2	**2**	**3**	**1**	**2**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**1**	**3**	**1**	**-**
ME2301-1.3	**2**	**3**	**1**	**2**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**1**	**3**	**1**	**-**
ME2301-1.4	**2**	**3**	**1**	**2**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**1**	**3**	**1**	**-**
ME2301-1.5	**2**	**3**	**1**	**2**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**1**	**3**	**1**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Timoshenko and Goodier, "Theory of Elasticity", Third Edition, Tata McGraw Hill Book Company, 2010.

REFERENCE BOOKS:

1.	.G.Sitharam, "Applied Elasticity", Interline publishing, 2008.
2.	2. L S Srinath, "Advanced Mechanics of Solids", Third Edition, Tata McGraw Hill Company, 2009.
3.	3. Sadhu Singh, "Theory of Elasticity", Khanna publishers, 2010..

Control Engineering

Course Code:	**ME2302-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**MA2003-1,MA2009-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the basic concept of control Engineering and to obtain mathematical model and transfer function of control system.
2.	Obtain overall transfer by reduction algebra and signal flow graph
3.	Obtain the response equation of control system
4.	Understand the concept of stability and obtain the stability of system using Nyquist and Bode methods.
5.	Obtain the system gain for stability by root locus plot and to understand the basic concept of control action

UNIT-I

Introduction:	**08 Hours**

Introduction: Control system , open and closed loop control systems, concept of feed back.
Mathematical Model: Transfer functions models, Models of mechanical systems, electrical systems, hydraulic systems and thermal systems.

Block diagram and signal flow graph:	**09 Hours**

Block diagram and signal flow graph: Block representation of system elements, example of the use of block diagrams, Block diagram Reduction, Signal flow graph, Mason's gain formula.

UNIT-II

System Responses:	**06 Hours**
System Responses: Types of input signals, First order and second order system response to step input, time response specification of second order system, numerical problems. System stability criteria, Routh stability criteria. Generation of standard test signals, Step response for the given transfer function, Time domain specification for the given transfer function using MATLAB	
Frequency Response	**04 Hours**
Frequency Response: Polar and rectangular plots for the frequency response, Nyquist stability criterion, stability analysis. Phase and gain margin. Stability analysis of linear systems using Nyquist plot in MATLAB	
	04 Hours
System Analysis using logarithmic plots: Bode diagrams: Stability analysis using Bode diagrams. Stability analysis of linear systems using bode plot in MATLAB.	

UNIT-III

	05 Hours
System Analysis using Root locus Plots: General rules for construction of Root Locus plots, analysis using root locus plot. Stability analysis of linear systems using root locus plot in MATLAB.	
	04 Hours
Control action: Basic concept of Proportional control, integral control, derivative control, proportional plus derivation control, PID control. Step response of P, PI, PID for a given transfer function using MATLAB	

Course Outcomes: At the end of the course student will be able to

1.	Illustrate open loop and closed loop control systems real life examples. Develop the mathematical model and transfer function of mechanical, electrical, hydraulic and thermal systems by applying the knowledge of mathematics and physics.
2.	Reduce the block diagram to open loop form using block diagram reduction algebra and signal flow graph (Mason's gain formula) in order to calculate overall transfer function of the system
3.	Develop the time response of 1st and 2nd order systems for unit step input. Calculate parameters of 2nd order under damped system response. Describe stability concept of control system and also Analyse the stability of the control system using R-H criterion.
4.	Analyse the stability of the control system using Nyquist criterion and Bode plot.
5.	Analyse the parameters related to stability of control systems using root locus plot. Describe the different types of control actions in control systems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2302-1.1	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**1**
ME2302-1.2	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**1**
ME2302-1.3	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**1**
ME2302-1.4	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**1**
ME2302-1.5	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Katsuhiko Ogata (2004) " Modern Control Engineering" Prentice Hall of India Ltd., New

	Delhi
2.	I. J. Nagarath and M. Gopal,(2002) "Control system" New Age International Publisher
REFERENCE BOOKS:	
1.	Harrison H.L. and Bollinger J.G. (1968) "Automatic controls", 2nd edition, International Text Book Co. U.S.A.
2.	Gopal M (2005) " Modern Control Systems", New Age International Publisher
3.	Benjamin.Kuo.C. (1995) "Automatic Control Systems", EEE, 7th Edition Prentice Hall of India Ltd. New Delhi
4.	Appukuttan K. K. Control Engineering , Oxford university publication, 2009

DESIGN OF EXPERIMENTS

Course Code:	**ME2303-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**MA2003-1,MA2009-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Explain Basic concept of experimental design and fundamentals of Statistics.
2.	Discuss basic concepts of Experimental design
3.	Discuss Analysis of variance and regression analysis
4.	Discuss Experimental Design approaches of Robust Design and Taguchi's orthogonal arrays
5	Explain the concepts of Signal to Noise Ratio, parameter design and tolerance design

UNIT-I

Introduction:	**08 Hours**
Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. Basic Statistical Concepts: Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples**.**	
Experimental Design:	**09 Hours**
Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples	

UNIT-II

Analysis And Interpretation Methods	**06 Hours**
: Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.	
Quality By Experimental Design:	**04 Hours**
Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples	
	04 Hours

Experiment Design Using Taguchi's Orthogonal Arrays: Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples

UNIT-III

Signal To Noise Ratio:	**05 Hours**

Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples

Parameter And Tolerance Design:	**04 Hours**

Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples.

Course Outcomes: At the end of the course student will be able to

1.	Explain Basic concept of experimental design and fundamentals of Statistics.
2.	Discuss basic concepts of Experimental design
3.	Discuss Analysis of variance and regression analysis
4.	Discuss Experimental Design approaches of Robust Design and Taguchi's orthogonal arrays
5.	Explain the concepts of Signal to Noise Ratio, parameter design and tolerance design

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2303-1.1	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**
ME2303-1.2	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**
ME2303-1.3	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**3**
ME2303-1.4	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**
ME2303-1.5	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Box GEP, Hunter JS, Hunter WG, 2005. Statistics for Experimenters. 2nd ed. Wiley.
2.	Design and Analysis of Experiments, 8ed, ISV (WSE) Paperback – 2013by Douglas C. Montgomery

REFERENCE BOOKS:

1.	Statistical Quality Control: Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
2.	Principles of Quality Control: Jerry Banks, Wiley & Sons, Inc. New York
3.	Total Quality Management: D.H. Besterfield et al., 2019, Pearson India Education Services Private Ltd
4.	Design and Analysis of Experiments: R. Pannerselvam, 2012, PHI Learning Private Limited, New Delhi

E Books / MOOCs/ NPTEL

1.	NPTEL course material related to operations management, TQM, operations research

Professional Elective Courses (Information Technology Stream)

DATA STRUCTURES

Course Code:	**ME1211-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Outline the concepts of data structures, types, operations, structures, pointers and implement pointers, structures and pointer to structures.
2.	Implement linear data structures stacks, queues and usage of stacks in various applications.
3.	Implement the operations of singly linked lists and circular linked lists, doubly linked list and circular doubly lists.
4.	Identify and differentiate different types of binary trees and binary search trees data structures and also implement them.
5.	Illustrate and classify threaded binary trees, expression trees, AVL trees, BTrees, B+ tree and techniques of hashing.

UNIT-I

INTRODUCTION:

Data Structure, Classification (Primitive and non-primitive), data structure operations, Arrays,Pointers and structures, Dynamic Memory Allocation Functions, Representation of a polynomials and polynomial addition.

LINEAR DATA STRUCTURES – STACKS:

Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks,

APPLICATIONS OF STACK:

Conversion of Expressions, Evaluation of expressions, Recursion: Implementation, Simulating Recursion, examples on Recursion.

15 Hours

UNIT-II

LINEAR DATA STRUCTURES – QUEUES:

15 Hours

Introduction and Definition Representation of Queue: Array and Structure , representation of Queue,

Various queue structures:ordinary queue, circular queue, priority queue

LINEAR DATA STRUCTURES - LINKED LISTS:

Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List, Circular Linked List, Doubly Linked List: Representation and Operations, Circular doubly Link list: Representation and Operations. Linked List representation of stack, Linked List representation of queue.

UNIT-III

NONLINEAR DATA STRUCTURES - TREE DATA STRUCTURES:

10 Hours

Basic Terminologies, Binary Trees: Properties, Representation of Binary Tree: Linear representation, Linked representation, Operations on Binary Tree: Insertion, traversals. Introduction to Binary Search Tree

Expression Tree: Constructing expression tree from postfix expression, traversals, Application of tree: Evaluation of expression, programming examples

Threaded binary Tree: types, B-Trees, B+ Trees, AVL Trees: Definition, Constructing a general AVL tree.

NONLINEAR DATA STRUCTURES – GRAPHS :

Representation of graphs: Set Representation, Linked representation, Matrix representation.

HASHING: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

Course Outcomes: At the end of the course student will be able to

1.	Acquire the fundamental knowledge of various types of data structures and pointers using that knowledge and design the programs using pointers.
2.	Apply the fundamental programming knowledge of data structures to design stack and use them for solving problems.
3.	Apply the fundamental programming knowledge of data structures to design queues and use them for solving problems.
4.	Design various functions for implementation of singly linked lists, circular linked lists and doubly linked list.
5.	Implement and apply the concept of binary trees and binary search tree data structure, advanced trees, representation of graphs and hashing techniques.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1211-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME1211-1.2	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME1211-1.3	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME1211-1.4	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
ME1211-1.5	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, "Data Structures using C", Pearson Education/PHI, 2009.
2.	Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2014.

E Books / MOOCs/ NPTEL

1.	Introduction to Data Structures by edx , URL: https://www.edx.org/course/
2.	Data structures by Berkley, URL: https://people.eecs.berkeley
3.	Advanced Data Structures by MIT OCW , URL: https://www.mooclab.club/

Introduction to Cognitive Computing

Course Code:	**ME1212-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To provide the students an overview about what cognitive computing and about its design principles, relationship with artificial intelligence, neural networks and big data
2.	To teach the fundamentals of cognitive computing design in terms of taxonomies, ontologies, about the role of cloud and distributed computing and the process of building a computing system.
3.	To discuss the different applications of cognitive computing through areas.
4.	To discuss the different applications of cognitive computing through examples
5.	To discuss the different applications of cognitive computing through case studies

UNIT-I

Introduction to Cognitive Computing	**15 Hours**
Content: cognition, cognitive computing systems, foundations of cognitive computing, design principles, cognitive computing architectures and approaches, cognitive computing systems and applications, cognitive computing and artificial intelligence, cognitive computing and neural networks. Natural language processing in Cognitive computing, Relationship between Big data and Cognitive computing, Machine learning and Deep neural networks	
UNIT-II	
Cognitive computing system design	**13 Hours**
Content: representing knowledge in Taxonomies and Ontologies, applying advanced analytics to cognitive computing – Cognitive analytics, role of cloud and distributed computing in cognitive computing. IBM Watson – introduction, history, development, IBM's Watson as a Cognitive System, applications, The Process of Building a Cognitive computing system. Internet of Things (IoT) and Cognitive Computing	
UNIT-III	
Cognitive computing Applications	**12 Hours**
Content: Health care, Education and Learning, Natural Language Processing Emerging Cognitive computing areas, Future applications of Cognitive computing, Selected topics from research papers, Real life examples	

Course Outcomes: At the end of the course student will be able to

1.	Describe cognitive computing in terms of its fundamentals, design principles, its relationship with artificial intelligence and machine learning,
2.	Describe its role in natural language processing, in managing big data and the role of machine learning and deep neural networks in cognitive computing.
3.	Demonstrate about the issues related to design of cognitive computing systems.
4.	Discuss the process of building a cognitive system and IBM Watson as a cognitive system. Discuss the role of the Internet of Things in cognitive computing systems.
5.	Discuss the applications of cognitive computing and its emerging areas and future applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1212-1.1	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1212-1.2	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1212-1.3	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1212-1.4	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1212-1.5	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**		
1: Low 2: Medium 3: High															

TEXTBOOKS:

1.	Hurwitz, Kaufman, and Bowles, Cognitive Computing and Big Data Analytics, Wiley, Indianapolis, IN, 2005, ISBN: 978-1-118-89662-4.
2.	Vijay Raghavan, Venkat Gudivada, Venu Govindaraju & C.R.Rao, "Cognitive Computing: Theory and Applications", Volume 35. 1st Edition, North Holland, 2016, ISBN: 9780444637444.

REFERENCE BOOKS:

1.	K.Hwang & M.Chen, Big-data analytics for cloud, IoT and cognitive computing, 2017 - books.google.com
2.	Any other web based source

Cloud Computing

Course Code:	**ME1311-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical

Course Objectives:

1.	Outline the fundamental ideas behind Cloud computing, and the evolution of the paradigm, its applicability, benefits as well as current and future challenges.
2.	Get the basic idea and principles in Datacentre design and Management and find the importance of Virtualization in Cloud.
3.	Get the idea of different Cloud deployment models and Cloud Delivery Models and their security issues.
4.	Tell how Cloud Computing solves different problems in the present by considering different
5.	Cloud Vendors and their Cloud Design architecture.

UNIT-I

Eras of computing, Parallels, Distributed Computing, **Elements of Parallel Computing-** (What is parallel computing, hardware architecture for Parallel processing, approaches to parallel programming, levels of parallelism, Laws of caution). **Elements of Distributed Computing-** (General concepts and definitions, components of a distributed system, Architectural styles for distributed computing, models for inter-process communication, Technologies for distributed computing-Remote procedure call, Service oriented computing). Classic data center, its elements, challenges, and benefits. Data center management Steps in transitioning to cloud-consolidation, automation, IT as a service. **Cloud computing Architecture-** Introduction, Cloud reference models- (Architecture, Infrastructure/Hardware as a service, Platform as a service, Software as a service), Types of cloud – (Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds), Economics of cloud, Open challenges.	**15 Hours**

UNIT-II

Virtualization– Introduction, characteristics of virtualized environments, taxonomy of virtualization technique- (execution of virtualization, other types of virtualizations- Compute, Storage, Network, Desktop, Application). Virtualization and cloud computing, Pros and Cons of virtualization, **Technology examples-** XEN, VMware, Microsoft Hyper- V. Security Concerns, **Risk Issues-** Cloud Computing- Security Concerns. A Closer Examination: Virtualization, A Closer Examination: Provisioning.	**15 Hours**

UNIT-III

The Purpose of Security Monitoring, Transforming an Event Stream, The Need for C.I.A. in Security Monitoring, the Opportunity for MaaS. **Case studies:** Public cloud- AWS, Windows Azure, Google App Engine. Private Cloud- Open stack, Eucalyptus.	**10 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Define the concept of cloud computing business need and various networking methods.
2.	Explain the infrastructure management for cloud environment.
3.	Describe the Virtualization at all levels using technology XEN, Vmware, Microsoft Hyper-v.
4.	Explain the security concepts in cloud computing and securing the cloud.
5.	Present case studies of public cloud such as AWS, Google App Engine and private cloud such as OpenStack.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
ME1311-1.1	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
ME1311-1.2	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
ME1311-1.3	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
ME1311-1.4	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
ME1311-1.5	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Buyya, Rajkumar, Christian Vecchiola and ThamaraiSelvi, "Mastering Cloud Computing Fundamentals and Applications Programming", McGraw Hill,2013.
2.	G, Somasundarm and Alok Srivatsa, "Information Storage and Managemnt.", EMC Education Services, Wiley Publishing Inc., 2009.
3.	Sitaram, Dinakar and Geetha Manjunath,"Moving to the Cloud – Developing Apps in the World of Cloud Computing", Elsevier,2012.
4.	Sosinsky, Barrie, "Cloud Computing Bible.", Wiley India Pvt. Ltd, 2013.
5.	Winkler, Vic (J.R), "Securing the Cloud - Cloud Computer Security Techniques and Tactics", Elsevier Inc., 2012.

REFERENCE BOOKS:

1.	Hurwitz, Judith, "Cloud computing for dummies", Wiley India Pvt Ltd,2011.
2.	Rittinghouse, John, "Cloud computing – implementation, management and security", CRC Press, First edition,2009.
3.	Velte, Toby, Anthony Velteand Robert Elsenpete "Cloud Computing, A Practical Approach.", Tata McGraw-Hill Authors, 2010.

E Books / MOOCs/ NPTEL

1.	www.motc.gov.qa/sites/default/files/cloud_computing_ebook.pdf
2.	http://eddiejackson.net/web_documents/The_Definitive_Guide_to_Cloud_Computing.pdf
3.	http://nptel.ac.in/courses/106106129/28
4.	https://www.coursera.org/learn/cloud-computing

Introduction to Machine Learning

Course Code:	**ME1312-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the concept of machine learning and identify issues related to machine learning algorithms
2.	Solve simple problems on multilayer perceptron
3.	Solve simple problems on radial basis function network
4.	Explain support vector machines
5.	Present some case studies on neural network models

UNIT-I

Introduction to machine learning	**08 Hours**

Content: need, applications, advantages and limitations. What is Artificial Intelligence? Difference between AI and ML, case study examples.

Linear models for classification	**08 Hours**

Content: Decision trees, Regression, Probability theory / distributions. Introduction to Neural networks – learning theory, classification, advantages, limitations, applications, feed forward networks, network training, Bias / variance tradeoff, generalization errors, model selection, VC dimensions

UNIT-II

Multilayer perceptron-	**07 Hours**

Content: Characteristics, error back propagation algorithm, XOR Problem, Heuristics for making the BP algorithm work better, Sequential and batch modes of learning, Generalization, Cross validation, Early stopping method of training.

Radial basis function neural networks	**08 Hours**

Content: Covers' theorem on Separability of patterns, XOR Problem , Comparison between MLP and RBFNN, Learning strategies- Fixed centers selected at random, Self-organized selection of centers, Supervised selection of centers , clustering algorithms, Dimensionality reduction, regularization and stability of Break-even analysis and Transportation method to make location decisions.

UNIT-III

Support Vector Machines and Kernel methods	**05 Hours**

Content: introduction, statistical learning theory, soft vs hard SVMs, multiclass SVMs, SVMs for regression, linear vs nonlinear SVMs, Kernel tricks, implementing soft-SVM with kernels, optimal hyperplane for linearly separable and non-separable patterns, VC dimension of SVMs

Introduction to relevant vector machines	**04 Hours**

Content: (RVM), difference between RVM and SVM, Introduction to Deep Learning Introduction to Convolutional neural network, Multilayer perceptron, Radial basis function neural networks and Support Vector Machines

Course Outcomes: At the end of the course student will be able to

1.	Explain about machine learning, identify its relation with artificial intelligence, apply linear models for classification and identify issues related to machine learning algorithms.
2.	Explain multi-layer perceptron in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems

3.	Explain radial basis function network in terms of its architecture, features, principle, advantages, disadvantages and applications and solve simple problems
4.	Explain support vector machines in terms of its principle, features, advantages, disadvantages and applications
5.	Explain about relevant vector machines and differentiate it from support vector machines, Convolutional neural network and deep learning and present some case studies on neural network models and support vector machines.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1312-1.1	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1312-1.2	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1312-1.3	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1312-1.4	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
ME1312-1.5	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
1: Low 2: Medium 3: High															

TEXTBOOKS:

1.	Neural Networks – A comprehensive Foundation, Simon Haykin, Pearson Prentice Hall, Second Edition, 2005, ISBN 81 – 7808 -300 - 0
2.	Understanding Machine Learning – from Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014, ISBN978-1-107-05713-5 Hardback
3.	Pattern Recognition and Machine Learning by Christopher Bishop, Springer, 2006, ISBN:978-0-387-310732
4.	Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, Part II, MIT Press, 2016.

REFERENCE BOOKS:

1.	Vapnik, V., An Overview of Statistical Learning Theory, IEEE Transac-tions on Neural Networks, Vol. 10, pp. 988-999, 1999.
2.	Christopher Burges, A Tutorial on Support Vector Machines for Pattern Recognition, Data Mining and Knowledge Discovery, 1998.
3.	Kurt Hornik, Maxwell Stinchcombe and Halbert White, Multilayer Feedfor-ward Networks are Universal Approximators, Neural Networks, 1989.
4.	Any text book on machine learning, neural networks, SVMs etc.

E Books / MOOCs/ NPTEL

1.	https://www.coursera.org/
2.	https://www.youtube.com/watch?v=zCwEdKy2OJI
3.	https://www.youtube.com/watch?v=vMmG_7JcfIc

Professional Elective Courses (Management Stream)

Maintenance and Reliability Engineering

Course Code:	**ME1221-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Get an idea on different types of maintenance done.
2.	Develop interest in maintenance planning and control over maintenance.
3.	Understand the implementation of RCM and TPM in maintenance.
4.	Gain knowledge on reliability engineering.
5.	Present importance of reliability and its implementation in mechanical applications.

UNIT-I

Introduction	**07 Hours**

Need for maintenance, objectives, functions and importance of maintenance systems, Type of maintenance systems – planned, breakdown, preventive, predictive, design-out, corrective, opportunistic, Total Productive Maintenance
Condition based maintenance – condition monitoring
Computers in maintenance – introduction, features and benefits

Maintenance planning and Scheduling	**09 Hours**

Planning of maintenance functions, manpower allocation, long range planning, short range planning, planning techniques and procedures, estimation of maintenance work, maintenance control, scheduling, objectives and stages of manpower planning, timescale of manpower planning, manpower for maintenance systems, Effective utilization of manpower, spare parts management, spares control.

UNIT-II

Reliability Centered Maintenance	**05 Hours**

Introduction, Functions, Functional Failures, Failure Modes and Effects Analysis (FMEA), Failure Consequences, Proactive Maintenance, Failure Finding, Default Actions

Total Productive Maintenance	**04 Hours**

Introduction, Development of Maintenance Systems, Pillars of TPM, Toyota Production System, TPM basic use and Ideal Conditions, Creating Standards and Preparation for Autonomous Maintenance, 5S

Introduction to Reliability	**07 Hours**

Definition, failure data analysis – introduction, failure data, MTTF, MTBF, Hazard model – introduction, Weibull model, some important distributions Numerical problems required.

UNIT-III

System reliability	**08 Hours**

Introduction, series, parallel, mixed configuration, series-parallel, parallel-series configurations, methods of solving complex systems. Reliability improvement – introduction, improvement of components, redundancy – types, optimization, reliability cost trade off Maintainability and Availability – introduction, reliability and maintainability trade off.

Course Outcomes: At the end of the course student will be able to

1.	Apply the knowledge of engineering fundamentals to different types of maintenance and basics of condition monitoring.
2.	Demonstrate knowledge on maintenance planning and scheduling along with manpower planning to manage projects in multidisciplinary environments.
3.	Create, select and apply the concept of reliability centered maintenance and total productive maintenance to complex engineering activities with an understanding of the limitations.

4.	Understand the impact of reliability and failure models and demonstrate the knowledge of different hazard models.
5.	Use research-based knowledge to understand the system reliability and reliability improvement of data to provide valid conclusions.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
ME1221-1.1	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**2**	**3**	**1**
ME1221-1.2	**1**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**
ME1221-1.3	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**
ME1221-1.4	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**1**	**2**	**1**	**3**	**2**	**3**	**1**
ME1221-1.5	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**3**	**1**	**3**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Reliability and Maintenance Engineering by R. C. Mishra, New Age International, 2006.
2.	Maintenance Engineering and Management by R.C.Mishra and K.Pathak, Prentice Hall of India, 2012.
3.	Maintenance Engineering Handbook by Higgins and Morrow, Tata McGraw Hill, 1985.
4.	Reliability Engineering by L.S.Srinath, Affiliated East West Press Pvt. Ltd., 2005.
5.	Reliability Centered Maintenance by John Moubray, industrial Press Inc. 2nd Edition
6.	Total Productive Maintenance by Steven Borris, McGraw Hill, 2006

REFERENCE BOOKS:

1.	Mechanical Fault Diagnosis and Condition Monitoring by R.A.Collacott, McGraw Hill, 1985.
2.	Management of Industrial Maintenance by Kelley A., and Harris, M.J., Newnes-Butter worth.
3.	Maintenance Engineering Handbook by Morrow, 2002.

Marketing Management

Course Code:	**ME1222-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand and learn the marketing concepts and their application to profit-oriented and non-profit oriented organizations.
2.	Able to apply the marketing concepts to analyze the buying behavior & marketing segments to solve these problems.
3.	Understand and learn the need for a customer orientation in product pricing & marketing research in the competitive global business environment;
4.	Able to develop an understanding and acquiring skills in how to successfully design and implement marketing plans and strategies.
5.	Understand and learn the concept of sales, advertising &distribution of marketing mix and its application in traditional and novel environments characterized by emerging information technologies.

UNIT-I

Basics:	**08 Hours**

Content: Definition, Marketing Process, Dynamics, Needs, Wants & Demands, Marketing Concepts, Environment, mix, types, philosophies, Selling Vs. Marketing, organization, Industrial Vs. Consumer Marketing, Consumer goods, Industrial goods, Product hierarchy

BUYING BEHAVIOUR & MARKET SEGMENTATION	**08 Hours**

Content: Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.

UNIT-II

PRODUCT PRICING & MARKETING RESEARCH	**07 Hours**

Content: Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction, Uses, process of Marketing Research

MARKETING PLANNING & STRATEGY FORMULATION	**06 Hours**

Content: Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.

UNIT-III

ADVERTISING, SALES PROMOTION & DISTRIBUTION	**11 Hours**

Content: Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition. Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends in retailing.

Course Outcomes: At the end of the course student will be able to

1.	Explain the basic marketing concepts
2.	Interpret the buying behaviour of customers and role of marketing segments
3.	Explain the role of product pricing and marketing research in the competitive global business environment
4.	Analyse the marketing plans and strategies.
5.	Explain the role of sales, advertising and distribution in marketing to achieve the goals of marketing

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1222-1.1	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**
ME1222-1.2	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**
ME1222-1.3	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**2**	**-**	**1**	**-**	**1**
ME1222-1.4	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**
ME1222-1.5	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**
1: Low 2: Medium 3: High															

TEXTBOOKS:

1.	Govindarajan. M. 'Modern Marketing Management', Narosa Publishing House, New Delhi, 1999.

REFERENCE BOOKS:

1.	Philip Kolter, " Marketing Management: Analysis, Planning, Implementation and Control ", 1998.
2.	Green Paul.E. and Donald Tull, " Research for Marketing Decisions ", 1975.
3.	Ramaswamy.V.S. and S.Namakumari, " Marketing Environment: Planning, Implementation and Control the Indian Context ", 1990
4.	Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies

E Books / MOOCs/ NPTEL

1.	https://www.bing.com

Operations Management

Course Code:	**ME1223-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the functions of various types of business organizations, Recognize the importance of operations function, apply important tools of Decision making in an organization setting.
2.	Apply different methods of forecasting and solve numerical problems.
3.	Analyze capacity and location planning and plant layout problems and Select best possible capacity, location and layout given the resources and information
4.	Understand the nature and scope of, various strategies and techniques of aggregate planning and Master Scheduling. Apply these strategies to arrive at the best aggregate plan and MPS
5	Discuss Material requirements planning and solve numerical problems. Generate Material requirement plan, with the available information

UNIT-I

Production and Operations Management:	**09 Hours**

Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity,
Decision Making: The decision process, characteristics of operations decisions, use of models - B.E.P and Transportation models, decision making environments. Decision trees

Forecasting:	**09 Hours**

Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, Regression and Correlation methods, accuracy and control of forecasts, Choosing a forecasting technique, Elements of a good forecast

UNIT-II

Capacity, Location and Layout Planning:	**06 Hours**

Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives.
Design, System an actual capacity. System efficiency and utilization. Determination of Equipment requirement for a single stage production processes. Numerical problems on the above

	04 Hours

Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions. Use of Break even analysis and Transportation algorithms for making location decisions. Facilities layout - Need for layout decisions. Minimizing material handling cost in process layout using Load distance analysis, Simple line balancing problems in product layouts

	04 Hours

Aggregate Planning & Master Scheduling: Aggregate planning - Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning - graphical and charting techniques, Mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods

UNIT-III

Material Requirement Planning (MRP):	**08 Hours**

Dependent versus independent demand, an overview of MRP - MRP inputs and outputs, MRP processing: An overview of MRP-II, JIT manufacturing and ERP, benefits and limitations of MRP. Capacity requirement planning

Course Outcomes: At the end of the course student will be able to

1.	Describe the process of operations management. Apply Break Even Analysis, Expected Monetary Valve (EMV) and decision tree methods of decision making to select optimal decision alternative
2.	Apply moving average, least squares, exponential smoothing and regression and correlation methods of forecasting to estimate the trend in demand when past sales/ independent variables are given. Apply the Seasonal Indexes to adjust the trend values. Estimate the forecast error and determine the forecast accuracy from the given data.
3.	Determine the design capacity, system capacity and system efficiency. Determine optimal facility location using Break even analysis and Transportation Method. Apply the method of transportation and load distance analysis to select optimal process plant layout. Apply the line balancing principles to determine cycle time and optimal grouping of machines in product layouts.
4.	Compare pure and mixed Aggregate planning strategies to determine the best aggregate plan. Determine the Master Production Schedule (MPS) considering the inventory and demand data.
5.	Develop a material requirement plan, based on the available information on .Bill of materials, Inventory data and Master Production Schedule..

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1223-1.1	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**
ME1223-1.2	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**
ME1223-1.3	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**
ME1223-1.4	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**
ME1223-1.5	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8th Edition. 2011
2.	Production / Operations Management, Joseph G Monks, McGraw Hill Books, 2001

REFERENCE BOOKS:

1.	Production and Operations Management, Norman Gaitmer & Greg Frazier,2011
2.	Operations Management for Competitive Advantage, R.B.CHase, NJ.Aquilino, F. Roberts Jacob; McGraw Hill Companies Inc., Ninth Edition
3.	Production & Operations Management, Everett E.Adams, Ronald J.Ebert, Prentice Hall of India Publications, Fourth Edition. 2001
4.	Operations Management-Theory and Practice, B Mahadevan, Pearson Education, 2007.
5	Production / Operations Management, R. Pannerselvam, PHI India, 2011

E Books / MOOCs/ NPTEL

1.	NPTEL course material related to operations management, TQM, operations research

Total Quality Management

Course Code:	**ME1224-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the meaning of quality and the development of quality terminology and explain the principles of TQM..
2.	Compute mean, median, mode and standard deviation and calculate area under the normal distribution and relate it to the quality concept
3.	Compute control limits for a variable chart and draw the X bar and R chart limits for attribute chart and draw p, np, c and u charts
4.	Explain the Acceptance Sampling plans and understand the concept of Design of Experiments

UNIT-I

Introduction:	**09 Hours**
The Meaning of Quality and Quality Improvement; Statistical Methods for Quality Control and Improvement; TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM. Principles of TQM: Leadership - Deming's philosophy, Customers' satisfaction - Customers perception, Feedback, Employee involvement - quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, Six sigma, ISO-9000, ISO-14000, ISO-18000 series of standards. Modeling Process Quality: Mean, Median, Mode, Standard deviation, calculating area, Normal distribution tables, Finding the Z score, Central limit theorem, 7 QC tools	
	09 Hours
Methods and Philosophy of Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL	

UNIT-II

	06 Hours
Control Charts for Variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems	
	04 Hours
Process Capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems	
	04 Hours
Control Charts for Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit. Numerical problems	

UNIT-III

	08 Hours
Lot-By-Lot Acceptance Sampling for Attributes: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Numerical problems. Introduction to Design of Experiments: Hypothesis testing, one sample t-test, orthogonal design of experiments, two factor experimental design, numerical problems on the above topics	

Course Outcomes: At the end of the course student will be able to

1.	Understand the concept of quality and evolution of quality concepts over the years
2.	Apply statistical concepts for solving simple quality problems
3.	Draw and analyze control charts for variables.
4.	Draw and analyze the control chart for attributes
5.	Understand the basic concepts of Acceptance Sampling and Design of experiments.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
ME1224-1.1	**2**	**1**	-	-	-	-	-	-	-	-	-	-	-	-	**1**
ME1224-1.2	**2**	**1**	-	-	-	-	-	-	-	-	**1**	-	-	-	**1**
ME1224-1.3	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-	-	**3**
ME1224-1.4	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-	-	**3**
ME1224-1.5	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-	-	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Statistical Quality Control: E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher, 2004.
2.	Statistical Quality Control: RC Gupta, Khanna Publishers, New Delhi, 3rd edition, 2005.
3	Total Quality Management: Dale H. Besterfield, Pearson Education, 3rd edition, 2011.

REFERENCE BOOKS:

1.	Statistical Process Control and Quality Improvement: Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2.	Statistical Quality Control for Manufacturing Managers: W S Messina, Wiley & Sons, Inc. New York, 1987
3.	Statistical Quality Control: Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
4.	Principles of Quality Control: Jerry Banks, Wiley & Sons, Inc. New York.
5	Design and Analysis of Experiments: R. Pannerselvam, PHI Learning Private Limited, New Delhi., 2012

E Books / MOOCs/ NPTEL

1.	NPTEL course material related to operations management, TQM, operations research

Management Information System

Course Code:	**ME1322-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To understand meaning, concepts, importance of Management, information systems and structure, classification of MIS.
2.	To know the meaning, concepts, types of Information and systems.
3.	To learn the development of system for MIS.
4.	To know the analysis and design of system for MIS.
5.	To know the decision-making function in MIS and Business applications of MIS.

UNIT-I

Introduction: Framework of Management Information Systems: Importance's of MIS, Concepts of Management, information, system, Definition of MIS, information technology and MIS, nature and scope of MIS, MIS characteristics and functions. Structure and classification of MIS: structure of MIS, MIS classification.	**07 Hours**
Information concepts: Definition, types of information: strategic information, Tactical information, Operational information. Information quality, dimensions of information, System concepts: Definition, Kinds of Systems, System related concepts, elements of systems, Human as an information processing system.	**09 Hours**

UNIT-II

Development MIS: System development stages: System investigation, system analysis, system design, construction and testing, implementation, maintenance. System development approaches (a brief introduction): waterfall model, prototyping, iterative enhancement model, spiral model.	**07 Hours**
System analysis: introduction, requirement definition, strategies for requirement definition, structured analysis tools: data flow diagram, data dictionary, decision trees.	**04 Hours**
System Design: objectives, conceptual design, design methods, detailed system design. System Implementation process, Hardware & software selection, system maintenance, evaluation of MIS.	**04 Hours**

UNIT-III

Decision making and MIS: Decision making, Simon's model of decision making, types of decisions, purpose of decision making, level of programmability, knowledge of outcomes, methods of choosing among alternatives, decision making and MIS.	**05 Hours**
Business applications of MIS: Introduction, Cross-functional Enterprise Information system, e-Business & e-Commerce. Brief introduction of functional information system, financial information system, marketing information system, production/ Manufacturing information system, human resources information system.	**04 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain meaning, concepts, importance of Management, information systems and structure, classification of MIS.
2.	Explain the meaning, concepts, types of Information and systems.
3.	Describe the development of system for MIS.
4.	Analyze and design the system for MIS.
5.	Describe the decision-making function in MIS and Business applications of MIS.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1322-1.1	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**1**
ME1322-1.2	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**1**
ME1322-1.3	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**1**
ME1322-1.4	**1**	**2**	**-**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**3**	**-**	**-**	**-**	**1**
ME1322-1.5	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**-**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Robert G. Murdick & Joel E. Ross & James R. Claggett, "Information Systems for Modern Management" PHI.
2. D. P. Goyal, "Management information systems", Macmillan India Ltd.
3. Waman S Jawadekar : Management Information Systems , Third Edition, Tata McGraw Hill, 2007.
4. James A O'Brien and George M Marakas : Management Information Systems, Seventh Edition, Tata McGraw Hill, 2006.

REFERENCE BOOKS:	
1.	Bentley,"System Analysis and Design", TMH
2.	A. Ziya Aktas, "Structured Analysis & Design of Information System", PHI.
3.	V. Rajaraman, "Analysis & Design of Information Systems", PHI.
4.	J. Kanter, "Management Information Systems", PHI.
5.	G.B. Davis & M.H. Olson, "Management Information Systems", McGraw Hill International.
6.	Ralph M Stair and George W Reynolds: Principles of Information Systems, 7th Edition, CEngage Learning, 2010.
7.	Steven Alter: Information Systems - The Foundation of E-Business, 4th Edition, Pearson Education Asia. 2011
8.	Mahadeo Jaiswal and Monika Mittal: Management Information System, 3rd Edition, Oxford University Press.
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/110105148
2.	https://www.mooc-list.com/go/4070

OPERATIONS RESEARCH

Course Code:	**ME1323-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Formulate and solve problems using graphical and simplex linear programming techniques
2.	Determine optimal solutions to a transportation problem using modified distribution method. Find the optimal solution for an assignment problem using Hungarian Approximation Method
3.	Solve sequencing problems using Johnson's algorithm and graphical method. Determine replacement policy for equipment which deteriorates gradually and for items that fail suddenly.
4.	Develop a simulation model using Monte Carlo technique and solve the problem. Solve two-person game to determine strategies in conflict situations depicted in problems.
5.	Construct network diagrams determine critical paths and float time. Analyze time cost trade off using crashing technique. Estimate expected project duration and variance using Program evaluation and review technique.

UNIT-I

Introduction -Definition, scope of Operations Research (OR) approach, advantages, and limitations of OR models, applications, Characteristics and phases of OR.	**02 Hours**
Linear Programming- I – Formulation and Graphic Solution – Introduction, mathematical formulation of Linear Programming Problems (LPP), Graphical Solution. **Simplex Method** –Introduction, Simplex method – slack, surplus and artificial variables	**06 Hours**
Transportation Problem -Introduction, formulation of transportation model, Basic feasible solution using different methods, Optimality method, Unbalanced transportation problem, Applications	**04 Hours**
Assignment Problem – Formulation, Balance, unbalanced assignment problem, Maximization problem.	**03 Hours**

UNIT-II

Sequencing – Introduction, the sequencing problem, Johnson's algorithm, n-jobs on 2 machines, n-jobs on 3 machines, n-jobs on m machines, 2 jobs on n machines, graphical solution, priority rules	**04 Hours**
Replacement Theory –Introduction, replacement policy for equipment which deteriorates gradually	**04 Hours**
Simulation –Introduction, process of simulation, Monte Carlo Simulation, Problems on simulation	**03 Hours**
Game Theory Introduction, Game models, Two-Person Zero-Sum games and their solution, Games with and without saddle point, dominance property, Graphical solution (2Xn, mX2 games)	**04 Hours**

UNIT-III

Project Management using Network Analysis – Introduction, Network construction, determining critical path, floats, scheduling by network, project duration, PERT – estimation of project duration, variance under probabilistic models, prediction of date of completion, Crashing of networks, least cost project scheduling	**10 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Formulate and solve problems using graphical and simplex linear programming techniques
2.	Determine optimal solutions to a transportation problem using modified distribution method. Find the optimal solution for an assignment problem using Hungarian Approximation Method
3.	Solve sequencing problems using Johnson's algorithm and graphical method. Determine replacement policy for equipment which deteriorates gradually and for items that fail suddenly.
4.	Develop a simulation model using Monte Carlo technique and solve the problem. Solve two-person games to find the strategies in conflict situations depicted in problems.
5.	Construct network diagrams determine critical paths and float time. Analyze time cost trade off using crashing technique. Estimate expected project duration and variance using Program evaluation and review technique.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1323-1.1	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**2**
ME1323-1.2	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**2**
ME1323-1.3	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**3**
ME1323-1.4	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**3**
ME1323-1.5	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**-**	**-**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	N.D.Vohra, Quantitative Techniques in Management, Tata McGraw-Hill Publishing Company Limited, Third Edition, 2008.
2.	Prem Kumar Gupta and D.S.Hira, Operations Research, S.Chand Publications, 2009.

REFERENCE BOOKS:

1.	Problems in Operations Research (Principles and Solutions), Prem Kumar Gupta, D S Hira- S.Chand & Company LTD, New Delhi 4th edition 2009
2.	Operations Research an Introduction, Taha H. A. 8th edition – Pearson Education 2007
3.	Operations Research, S. D. Sharma -Kedarnath Ramnath & Co 2002.
4.	PERT & CPM", L. S. Srinath, New Delhi 3rd edition 2001

E Books / MOOCs/ NPTEL

1.	NOC:Introduction to Operations Research, IIT Madras Prof. G. Srinivasan https://nptel.ac.in/courses/110106062
2.	VTU e-learning EDUSAT Operations Research Course material for B.E and MBA.

ORGANIZATIONAL BEHAVIOR

Course Code:	**ME1324-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.

5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

Introduction	
Conceptual Foundation of Organisational Behaviour; Nature and Characteristics; Determinants; Contributing Disciplines; Challenges and Opportunities for Organisational Behaviour, Models and Approaches of Organizational Behaviour, OB and Emotional Intelligence.	**07 Hours**
Perception, Attitude, and Values: Nature, Process, Importance, Factors Influencing Perception; Attribution Theory of Perception; Issues Involved in Perception: Selective Perception, Halo Effect, Contrast Effect, Projection, Stereotyping; Concept of Pygmalion Effect; an overview of Emotions and feelings, Values, Beliefs and Attitudes with Managerial Implications. Learning: Concept; Theories of Learning: Conditioning, Social Learning, Managerial Implication of Learning Theories. Reinforcement. Motivation: Concept, Major Theories and Process of Motivation: Maslow's Need-Hierarchy Theory; Herzberg's Motivation-Hygiene Theory; Mcgregor's Theory X and Theory Y; Goal- Setting Theory; ERG Theory; Vroom's Expectancy Theory; Equity Theory; Managerial implications of Various Theories;	**08 Hours**
UNIT-II	
Leadership: Concept and Functions; Style and Theories of Leadership: Traits, Behavioural and Situational/ Contingency Groups of Theories; Inspirational approaches to Leadership; Charismatic Leadership, Transformational Leadership, and Transactional Leadership, Contemporary Leadership Roles; Challenges to the Leadership Construct; Substitutes and Neutralizers to Leadership.	**07 Hours**
Group Behaviour: Groups: Concept and Classification; Stages of Group Development; Group Structure; Roles and Norms; Premise and Issues; Group Decision-Making: Group vs Individual; Groupthink and Groups Shift; Group Decision Making Techniques and Process. Conflict Management: Concept; Causes; Types; Stages; Effects; Management of Conflicts	**08 Hours**
UNIT-III	
Organisational Culture: Concept; Dominant Culture; Strong vs Weak Cultures ; Creating and Sustaining Culture; Employees Learning of The Culture; Creating a Customer-Responsive Culture. Organisational Changes: Concept and Forces for Change; Managing Planned Changes; Resistance to Change; Approaches to Manage Organisational Change; Organisational Development; Culture-Boundedness of Managing the Change.	**10 Hours**
Course Outcomes: At the end of the course student will be able to	

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.

5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
ME1324-1.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**1**
ME1324-1.2	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**1**
ME1324-1.3	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**1**
ME1324-1.4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**1**
ME1324-1.5	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Robbins, SP Stephen P, Timothy Judge and Nehasika Vohra, Organisational Behaviour, 12th or 16th edition, Pearson Education, 201
2.	Fred Luthans, Organisational Behaviour, 11th edition, Mc Graw Hill,2009.

REFERENCE BOOKS:

1.	W. Newstrom, John, Organisational Behaviour,10th edition, Tata Mc Graw –Hill 2009.
2.	Organisational Behaviour -Dr.Ashwathappa, Himalaya Publishing House, 2015
3.	Dr SS Khanka, Organisational Behaviour, S. Chand & Co, New Delhi, 2008.
4.	Sanghi Seema, Organisational Behaviour, Pearson, 2011

E Books / MOOCs/ NPTEL

1.	https://www.coursera.org/learn/organisational-behaviour-know-your-people

SUPPLY CHAIN AND LOGISTIC MANAGEMENT

Course Code:	**ME1325-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Know the significance of supply chain management, its drivers, how to build a strategic framework and designing the supply chain network.
2.	Know about the models of facility location and evaluation of network design.
3.	Understand the requirements of planning and managing inventories in a supply chain and sourcing and selecting suppliers.
4.	Ascertain the role of information technology in supply chain management.
5.	Know about logistics management and some of the emerging trends in supply chain and logistics management.

Introduction

BUILDING A STRATEGIC FRAME WORK TO ANALYSE SUPPLY CHAINS: Supply chain stages and decision phase, process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit, Case discussions.	**07 Hours**
DESIGNING THE SUPPLY CHAIN NETWORK: Distribution	**08 Hours**

Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors,Framework for Design Decisions. **FACILITY LOCATION AND NETWORK DESIGN:** Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using	
UNIT-II	
	07 Hours
PLANNING AND MANAGING INVENTORIES IN A SUPPLY CHAIN: Review of inventory concepts. Trade promotions, Managing multi- echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability; importance factors. Managerial leversto improve supply chain profitability. **SOURCING, TRANSPORTATION AND PRICING PRODUCTS:** Role of sourcing, supplier – scoring & assessment, selection and contracts. Designcollaboration. **COORDINATION AND TECHNOLOGY IN THE SUPPLY CHAIN:** Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination.Managerial levers to achieve co-ordination, Building strategic partnerships, The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of e-business in a supply chain, The e-business framework, e-business in practice. Case discussion.	**08 Hours**
UNIT-III	
LOGISTICS MANAGEMENT: introduction, definition, systems approach, key logistics activities, developing logistics strategy, logistics information systems, transportation, warehousing, Global logistics. **EMERGING CONCEPTS:** Reverse Logistics, Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains	**10 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain the significance of supply chain management, its drivers, how to build a strategic framework and designing the supply chain network.
2.	Discuss about designing the supply chain network.
3.	Explain about the requirements of planning and managing inventories in a supply chain and sourcing and selecting suppliers.
4.	Elaborate the role of coordination and technology in supply chain.
5.	Explain the need, significance and the latest concepts in logistics and supply chain management.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
ME1325-1.1	**3**	**1**	-	-	-	**1**	**1**	-	-	-	**1**	-	-	-	**1**
ME1325-1.2	**3**	**1**	-	-	-	**1**	**1**	-	-	-	**1**	-	-	-	**1**
ME1325-1.3	**3**	**1**	-	-	-	**1**	**1**	-	-	-	**1**	-	-	-	**1**
ME1325-1.4	**3**	**1**	-	-	-	**1**	**1**	-	-	-	**1**	-	-	-	**1**
ME1325-1.5	**3**	**1**	-	-	-	**1**	**1**	-	-	-	**1**	-	-	-	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Supply Chain Management – Strategy, Planning & Operation - Sunil Chopra & Peter Meindl - Pearson Education Asia - ISBN: 81-7808-272- 1. – 2001.

2.	Fundamentals of Logistics management – Douglas M.Lambert, James R.Stock & Lisa M. Ellram, Irwin McGraw-Hill, 2000.
REFERENCE BOOKS:	
1.	Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems - Robert B Handfield, Ernest L Nichols, Jr. - Pearson Education Inc - ISBN: 81-297-0113-8. - 2002.
2.	Modelling the Supply Chain -Jeremy F Shapiro, Duxbury - Thomson Learning – ISBN 0-534-37363. -2002.
3.	Designing & Managing the Supply Chain -David Simchi Levi, Philip Kaminsky & Edith Simchi Levi - Mc Graw Hill.
4.	Supply Chain and Logistics Management – Upendra Kachuru
E Books / MOOCs/ NPTEL	
1.	https://www.coursera.org/learn/organisational-behaviour-know-your-people

Professional Elective Courses (Manufacturing & Automation)

COMPUTER INTEGRATED MANUFACTURING

Course Code:	**ME2231-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the process of usage of automation in manufacturing systems.
2.	To know the basic elements and also to analyze the production elements.
3.	To know how to analyze the automated assembly system.
4.	To know the different methods of quality control using computer.
5.	Understand the uses and applications of different material handling and storage systems.

UNIT-I

Computer Integrated Manufacturing System	**07 Hours**

Introduction, Types of automation, Manufacturing support systems, Automation in production systems, Automated manufacturing systems, Computerized manufacturing support systems, Reasons for automating, Production concepts & mathematical models, Automation strategies.

Transfer Lines and Similar Automated Manufacturing Systems	**09 Hours**

Fundamentals of automated production lines, System configurations, Work part transfer mechanisms, Storage buffers, Storage buffers between two stages of the production line, Control functions, Applications of Automated production lines.

UNIT-II

Analysis of Automated Flow	**06 Hours**

Analysis of transfer lines with no internal storage, Analysis of transfer lines with storage buffers.

Automated Assembly System	**04 Hours**

Fundamentals of automated assembly systems, System configurations, Parts delivery at workstations, Sign for automated assembly.

Quantitative analysis of assembly systems	**04 Hours**

Parts delivery at workstations, multi-station automated assembly systems and single station automated assembly systems and partial automation

UNIT-III

Computer Aided Quality Control	**05 Hours**

Contact inspection methods, Non-contact inspection methods, Co-ordinate measuring machine, Automated Storage/Retrieval Systems, Automated guided vehicle systems Types & Applications of AGVs, Vehicle guidance technology, Vehicle management and safety.

Material Handling Systems	**05 Hours**

Automated storage/retrieval systems (AS/RS) – Introduction, Types & Applications, Reasons for installing AS/RS, Carousel storage system.

Course Outcomes: At the end of the course student will be able to

1.	Apply engineering specialization & analysis for solution on managing the production system.
2.	Conduct investigation on problems on production system for betterment of engineering society.
3.	Understand the impact of management on the industrial environment and ethics.
4.	Function effectively in managing the industrial management as individual & team with better communication.
5.	To effectively manage the activities of the industrial environment to assist in project management and financial activities with scope of lifelong improvement.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2231-1.1	**3**	**3**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**-**
ME2231-1.2	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**1**	**2**	**-**
ME2231-1.3	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**-**
ME2231-1.4	**2**	**1**	**2**	**2**	**1**	**-**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**-**
ME2231-1.5	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	M.P. Grover. "Automation, Production Systems & Computer Integrated Manufacturing" Prentice Hall, third edition, 2008.
2.	Groover Mikell P. and Zimmer Emory W. (2003) "Computer Aided design and Manufacturing" Prentice Hall Publications, New Delhi
REFERENCE BOOKS:	
1.	CAD/CAM Principles and Applications, Rao P.N. Tata McGraw Hill, Second Edition, 2004.
2.	Principles of Computer Integrated Manufacturing- Vajpayee S.Kant. Prentice Hall of India, New Delhi,1999.
E Books / MOOCs/ NPTEL	
1.	https://www.elsevier.com/books/computer-integrated-anufacturing/weatherall/978-0-408-00733-7
2.	https://archive.nptel.ac.in/courses/112/104/112104289/
3.	https://mooc.es/course/computer-integrated-manufacturing/

Welding Technology

Course Code:	**ME2232-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Describe the principles of various conventional welding processes. Analyze the set-up and operation in arc welding processes such as SMAW, GMAW and TIG
2.	Illustrate the principles of advanced welding processes such as plasma welding, electron beam welding, laser welding. Analyze metallurgical issues associated with welding.
3.	Describe and apply various methods of Destructive and Non Destructive testing in weld joint, Inspection & testing. Apply the procedures related to welding joint design.
4.	Describe welding distortion and residual stress.
5.	Describe overall theoretical aspects for better employability in fabrication/welding application areas and health & safety issues.

UNIT-I

Introduction to Welding processes **Conventional welding and advanced welding processes**	**08 Hours**

Content: Shielded metal arc welding, gas welding and cutting, submerged arc welding, tungsten arc welding, gas metal arc welding, and resistance welding process.

Advanced welding process	**08 Hours**

Content: Plasma welding, cutting, Metal cladding, electron beam welding, laser beam welding, Welding Metallurgy Weldability of carbon steel, weldability of Stainless steel, weldability of non-ferrous materials like titanium and aluminum.

UNIT-II

Testing and quality control	**07 Hours**

Content: Destructive testing, Non-destructive testing such as liquid penetrant inspection, magnetic particle inspection, ultrasonic testing, radiographic testing

Welding Design	**08 Hours**

Content: Welding symbols, weld joint design, static and fatigue design, distortion and residual stresses. Welding productivity and economics. Expert systems in welding

UNIT-III

Developments and applications in welding Technology	**09 Hours**

Content: Welding application to pressure vessel, structures, ship building, and automobile. Welding robots and automation. Introduction to welding codes, ASME code. Precautions for electrical safety, fire hazards, fumes and use of different personal protective equipment for different processes

Course Outcomes: At the end of the course student will be able to

1.	Describe the principles of various conventional welding processes. Analyze the set-up and operation in arc welding processes such as SMAW, GMAW and TIG.
2.	Illustrate the principles of advanced welding processes such as plasma welding, electron beam welding, laser welding. Analyse metallurgical issues associated with welding.
3.	Describe and apply various methods of Destructive and Non Destructive testing in weld joint, Inspection & testing.
4.	Apply the procedures related to welding joint design. Describe welding distortion and residual stress
5.	Describe overall theoretical aspects for better employability in fabrication/welding application areas and health & safety issues

Course Articulation Matrix :

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
ME2232-1.1	**3**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**2**	**-**
ME2232-1.2	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**
ME2232-1.3	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**
ME2232-1.4	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**-**
ME2232-1.5	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Welding Engineering and Technology by Dr. R.S. Parmar, Khanna Publishers, ISBN-13: 978-81-7409-028-2, 1374 pages, 2016.
2.	A Text-Book of Welding Technology, by O.P. Khanna, Dhanpat Rai Publications; 2013 edition (2011)

REFERENCE BOOKS:

1.	Welding handbook by American Welding Society, 9th edition, Volumes 1 to 5.
2.	Welding Handbook, American Welding Society, Section-II: Gas Arc and Resistance
3.	The Science and Practice of Welding, Vol-2: The Practice of Welding: A. C. Davies, Cambridge University Press (Website: www.cambridge.org).

Automation in Manufacturing Systems

Course Code:	**ME3231-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To understand the concepts of automation in manufacturing systems
2.	To impart the knowledge of a line balancing and assembly systems
3.	To explore the idea of robotics and understand the computerized manufacturing planning
4.	To gain the knowledge of automated inspection and shop floor control
5.	To understand the concepts of additive manufacturing and latest trends in manufacturing

UNIT-I

Introduction	**04 Hours**

Production system facilities, Manufacturing support systems, Automation in production systems, Automation principles &strategies

Manufacturing Operations:	**04 Hours**

Manufacturing operations, Product/production relationship, Production concepts and Mathematical models & costs of manufacturing operations. Problems on mathematical models

Line Balancing	**05 Hours**
Methods of line balancing, Numerical problems on largest candidate rule, Kilbridge's and Wester's method, and ranked positional weights method, computerized line balancing methods.	
Automated Assembly System	**04 Hours**
Design for automated assembly, types of automated assembly system, Parts feeding devices, Analysis of single and multi-station assembly machines	
UNIT-II	
Computerized Manufacture Planning and AGVS	**06 Hours**
Computer aided process planning (CAPP), Retrieval and Generative systems, and benefits of CAPP. Material requirement planning, Inputs to MRP system, working of MRP, Outputs and benefits. Automated Guided Vehicles System: Applications, Guidance and routing,	
Industrial Robotics	**04 Hours**
Definition, Robot anatomy, Joints and links, Robot configurations, Robot control systems, Accuracy and repeatability, End effectors, Sensors in robotics. Industrial robot applications: Material handling, Processing, assembly and inspection.	
Inspection Technologies	**04 Hours**
Automated inspection, coordinate measuring machines construction, Operation & programming, Software, application &benefits, Flexible inspection system, Inspection probes on machine tools, Machine vision, Optical inspection techniques & non-contact non-optical inspection technologies.	
UNIT-III	
Shop Floor Control and Automatic Identification Techniques	**04 Hours**
Shop floor control, Factory data collection system, Automatic identification methods, Bar code technology, Automatic data collection systems. An Introduction to QR Code Technology	
Additive Manufacturing Systems	**03 Hours**
Basic principles of additive manufacturing, Slicing CAD models for AM, Advantages and limitations of AM technologies, Recent trends in manufacturing, Hybrid manufacturing.	
Future of Automated Factory:	**02 Hours**
Trends in manufacturing, the future automated factory, Human workers in future automated factory, Social impact.	

Course Outcomes: At the end of the course student will be able to

1.	Explain the basics of productions, automation system and manufacturing operations. Solve the simple problems on mathematical model.
2.	Analyze and solve problems on line balancing
3.	Explain CAPP and MRP system and analyze the AGVS
4.	Understand the inspection technologies and shop floor control
5.	Explain the modern trends in additive manufacturing and automated factory

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME3231-1.1	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME3231-1.2	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME3231-1.3	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME3231-1.4	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME3231-1.5	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**

1: Low 2: Me1dium 3: High

TEXTBOOKS:

1.	Mikell PGroover, Automation, Production Systems and Computer-Integrated Manufacturing, PHI Learning, 3rd Edition, 2009

2.	P N Rao, CAD / CAM Principles and Applications, Tata McGraw-Hill, 3rd Edition, 2015
3.	Ian Gibson, David W. Rosen, BrentStucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2nd Ed. (2015)
REFERENCE BOOKS:	
1.	Dr.Nanua Singh, Systems Approach to Computer Integrated Design & Manufacturing, Wiley, 1996
2.	P. Radhakrishnan, S. Subramanyan, U.Raju, CAD/CAM/CIM, Revised Third Edition 2007

SURFACE ENGINEERING

Course Code:	**ME3232-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1007-1,ME1101-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the basics of surface engineering with more focus on surface integrity
2.	Understand various surface damages and surface modification techniques which are in practice
3.	Improve knowledge about machining techniques and various parameters affecting the surface integrity
4.	Have in-depth knowledge about surface integrity measurement techniques to enhance the surface properties of materials

UNIT-I

	03 Hours
Surface Engineering - introduction and need. Surface-Subsurface - properties. Surface Modification Techniques (SMT) – Classification, Comparison, Scope, Issues & Application	
	02 Hours
Surface Damage – types and evaluation. Wear – types, properties.	
	11Hours
Surface Modification Techniques – Mechanical methods, Thermal methods, Diffusion based methods, Melting based methods, Dipping methods, Electrolysis based methods, Other methods.	

UNIT-II

	05 Hours
Surface Integrity (SI) – Introduction. Importance of SI in Functional Performance in Machining. Machining processes – Turning, Milling, Drilling, Other processes. Types of cutting – Orthogonal & Oblique,	
	10 Hours
Process parameters – dry vs cryogenic conditions, rake angle, relief angle, nose radius, feed rate, cutting velocity, depth of cut. Effect of process parameters on surface integrity. Surface Integrity evaluation measures – Forces, Temperature, Hardness, Surface Roughness, Microstructure and Residual Stresses.	

UNIT-III

	09Hours

Surface Integrity Measurement Techniques. Hardness – Rockwell, Brinell, Vickers. Surface Roughness – Contact type & Non-Contact type. Residual Stress – Destructive type (Hole Drilling, ESPI, Layer Removal), Non-Destructive type (XRD, ND, Ultrasonic, Magnetic, Raman). Microstructure – Optical Microscopy, Scanning Electron Microscopy. Numerical analysis approach – Finite Element Methods

Course Outcomes: At the end of the course student will be able to

1.	Explain surface engineering and discuss about surface damage
2.	Elaborate about different surface modification techniques in terms of their principle, applications, advantages and disadvantages
3.	Explain the significance of surface integrity and its importance in functional performance of components and the role of machining in modifying surface integrity
4.	Describe the influence of process parameters on the surface integrity achieved from different machining processes and the identify different surface integrity evaluation measures
5.	Explain the different surface integrity parameters like hardness, roughness, microstructure and residual stress measurement techniques, including use of numerical analysis methods.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME3232-1.1	**3**	**1**	**1**			**-**	**-**	**-**	**-**	**-**	**-**	**1**		-	3
ME3232-1.2	**3**	**1**	**1**			**-**	**-**	**-**	**-**	**-**	**-**	**1**		-	3
ME3232-1.3	**3**	**1**	**1**			**-**	**-**	**-**	**-**	**-**	**-**	**1**		-	3
ME3232-1.4	**3**	**2**	**2**	**1**		**-**	**-**	**-**	**-**	**-**	**-**	**1**		-	3
ME3232-1.5	**3**	**2**	**2**	**1**		**-**	**-**	**-**	**-**	**-**	**-**	**1**		-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	D K Dwivedi, Surface Engineering: Enhancing life of tribological component, Springer (2017) New Delhi
2.	Paolo Davim J, Surface Integrity in Machining, Springer, 2010
3.	Markopoulos Angelos P, Finite Element Method in Machining Processes, 2013

REFERENCE BOOKS:

1.	ASM Handbook, Surface Engineering, ASM, 1995
2.	Zhengwen Pu, Cryogenic Machining and Burnishing of AZ31B Magnesium Alloy for Enhanced Surface Integrity and Functional Performance, University of Kentucky, Lexington, Kentucky, 201

MOOC/NPTEL Resources:

1	https://nptel.ac.in/courses/112/107/112107248/

Additive Manufacturing

Course Code:	**ME2331-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0:2**	**Credits:**	**3**
Total Teaching Hours:	**30+0+0+0+15**	**CIE + SEE Marks:**	**50+50**

Prerequisite	ME1006-1

Teaching Department:

Course Objectives:

1.	To get acquainted with various Materials, Manufacturing methods & Machines adopted in Additive Manufacturing
2.	To understand Pre-processing and Post-processing in Additive Manufacturing
3.	To make the design for manufacturing to various Processes
4.	To impart knowledge on Prototype development & Rapid tooling

UNIT-I

Title: Introduction to Additive Manufacturing and Processes	**Duration**

Material Addition in Manufacturing- Comparison with subtractive manufacturing, Evolution, and Sequential procedure. Support Generation

Vat Photopolymerization, Extrusion Based systems, Material Jetting Process, Binder Jetting process, Sheet based Additive Manufacturig, Directed Energy Deposition, and Ion Beam writing Technologies.

Title : Materials for Additive Manufacturing

Polymers- Polymerization & Processing, Near Net shape Manufacturing of Plastic components, Plastic Injection moulding techniques, Polymer Matrix composites, and Composite manufacturing. Material science & Metallurgy in Additive Manufacturing- Metals, alloy & Metal Matrix composites in Additive Manufacturing, and Material characterization Techniques.

6 Hrs

UNIT-II

Title: Design for Additive Manufacturing & Assembly	**Duration**

Design for manufacturing and Assembly (DfMA)- Design guidelines, Design analysis, Quality, and sustainability in DfMA. Direct Digital Manufacturing- process selection and Cost estimation.

Machines- Types, Material delivery, Energy delivery, Nozzle, Heating systems, Hybrid Manufacturing

6 Hrs

Title: Working principles of Additive Manufacturing Processes	**Duration**

Sub title:
Stereolithography, DLP:
Wire based Additive Manufacturing:
Laser beam- Laser Beam Tracing, Laser CVD, Laser Sintering, and Laser Melting.
Electron Beam-Electron Beam CVD, Tracing, and Constraints in electron beam utility.
Powder Fusion Mechanisms-Powder handling techniques, Selective Laser Sintering, Powder Bed Fusion, and Defect analysis.

6 Hrs

UNIT-III

Title: Post Processing & Rapid Tooling	**Duration**

Post Processing- Support Material Removal, Surface Texture, Aesthetics, and Property Enhancements.
STL files- Software issues, File manipulation, Software to assist Additive Manufacturing.
Rapid Tooling-Rapid Bridge tooling, Express Tool Process, Soft Tooling, Hard Tooling, Properties of Tools manufactured using Additive manufacturing, and Rapid tooling Applications

6 Hrs

Title: Conceptual support systems	**Duration**

Electronics Manufacturing- The bottom-up approach, Wafer Preparation Techniques, Chip Manufacturing Techniques, and surface coatings.
Electronics and Interfacing in Additive manufacturing, Precision Manufacturing, Sustainability concepts, concurrent engineering, and Reverse Engineering.
Additive manufacturing in Medical applications

6 Hrs

Course Outcomes: At the end of the course student will be able to

1.	Understand the different methods and the control parameters of Additive Manufacturing processes.
2.	Apply the theoretical concepts to select an appropriate process and materials compaitable with Additive Manufacturing processes
3.	Optimize and Analyse the process parameters for making defect-free components with suitable post-processing operations
4.	Design and develop a working model using additive manufacturing Processes
5.	Design for Additive Manufacturing components and develop a prototype 3Dprinting machine

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
1	3												3		3
2	3	3	2										3		3
3	3	2	2				2						3	2	3
4	3	3	2										3		3
5	3	1	1				1						3		3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing (Second Edition)- Ian Gibson, Springer Publications
2.	Design and Applications of Additive Manufacturing and 3D Printing (2022)- Mika Salmi, MDPI Publications

REFERENCE BOOKS:

1.	Understanding Additive Manufacturing- Rapid Prototyping · Rapid Tooling · Rapid Manufacturing- Andreas Gebhardt, Hanser Publications, Cincinnati
2.	Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw-Hill, 2021.

E Books / MOOCs/ NPTEL

1.	https://www.rapidmade.com/design-for-additive-manufacturing
2.	https://all3dp.com/1/design-for-additive-manufacturing-dfam-simply-explained/#where-tolearn-dfam
3.	https://www.mmsonline.com/articles/cnc-machining-as-a-business-strategy-for-3d-printing

Digital Technologies including CPS,IIOT &Cloud in Manufacturing

Course Code:	**ME2235-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0:2**	**Credits:**	**3**
Total Teaching Hours:	**30+0+0+0+15**	**CIE + SEE Marks:**	**50+50**

Mechanical Engineering

Course Objectives:

1.	Describe the theoretical aspects of Digital Manufacturing
2.	Explain the Drivers and Technologies of Digital manufacturing
3.	Understanding the Product Lifecycle Management and Value Chain Management
4.	Describe the technical impact of digital manufacturing through the use of AI, CPS, and IIOT
5.	Show the Robotic ARM for Industrial Automation with an embedded-C, Cyber Physical System
6.	Create a smart factory using the use case study as a guide

UNIT-I

Evolution of Industry 4.0 and Smart tools	**6 hrs**

Introduction to Digital transformation- Evolution of digital manufacturing, Drivers of digital transformation, Introduction to Cyber physical system, Internet of things, Digital thread and twin.
Evolution of Industry 4.0 – Origin of Industry 4.0, Key components, Connectivity of components, Design principles, Architecture models in Industry 4.0, Digital Resource Modelling and Simulation - Factory Model.
Technology for Smart Design and Manufacturing - Geometric Modelling and kernals, Simulated motion analysis of Machine component, CAE -Implementation, Geometric Dimensioning and Tolerancing (GD&T).

Smart Factory	**6 hrs**

Digital Product life cycle (PLM) and Value Chain – Elements in PLM, Digital product life cycle, Connectivity of Enterprise Resource Planning (ERP), PLM platform, Digital Transformation of Supply chain, Integration of Value Chain.
Digital enabled Applications -Robotic Process Automation (RPA), Robot work flow Management, Machine health monitoring, Smart material flow, Additive Manufacturing Process Chain, Process Selection of Additive Manufacturing.
Smart Factory Initiatives - Smart Energy Management system, predictive maintenance, Horizontal vertical Integration in smart factory, Augmented reality, Quality Management 4.0.

UNIT-II

Cyber Physical System (CPS)	**6 hrs**

Demystifying Cyber Physical Systems- Evolution of Processors, Making Processor Chips from Sand, Embedded Memory Systems, Sensors and Actuators in Cyber Physical Systems, Serial Communication and protocols in CPS
Design and Development of CPS - Interfacing Sensors with ARM Cortex Processor – Humidity, Temperature, Ultrasonic Distance Sensor, Sound, Current, Voltage, moisture and Hall effect sensors
Design of Robotic ARM – Degree of freedom in robots, controlling solenoids in Hydraulics and Pneumatics, Introduction to Ardiuno nano, Interfacing servo motor using ardiuno nano
Demo examples

Industrial Internet of Things (IIOT) fundamentals and use cases	**6 hrs**

Demystifying Cyber Physical Systems- Evolution of Processors, Making Processor Chips from Sand, Embedded Memory Systems, Sensors and Actuators in Cyber Physical Systems, Serial Communication and protocols in CPS
Design and Development of CPS - Interfacing Sensors with ARM Cortex Processor – Humidity, Temperature, Ultrasonic Distance Sensor, Sound, Current, Voltage, moisture and Hall effect sensors
Design of Robotic ARM – Degree of freedom in robots, controlling solenoids in Hydraulics and Pneumatics, Introduction to Ardiuno nano, Interfacing servo motor using ardiuno nano

Demo examples

UNIT-III

Fundamentals of Cloud services and Artificial Intelligence (AI)	**6 hrs**

Cloud services - Relational model of cloud with Industry 4.0; Adoption Trends and Manufacturing Infrastructure; Building Blocks of Cloud Computing; Cloud Service Models: Paas, FaaS and CaaS
Implications of AI in Industry 4.0 - AI Layer in Digital Factory Framework, Fundamental of AI and Edge Devices, Scope of Machine learning (ML) in Digital Transformation, Preparing Data for Optimization in production manhours - Demo with EDA procedures, Deep Learning Techniques in Construction Industry
Demo Exercises

Course Outcomes: At the end of the course student will be able to

1.	Describe the various technologies used in Digital manufacturing.
2.	Illustrate how the data is shared in Digital Manufacturing to simplify the process.
3.	Evaluate the feasibility of implementing Digitalization.
4.	Show the fundamental ideas behind CPS and IIOT technologies' perspectives.
5.	Design project works concerning Robotics and Digitalization.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
1	1	3			2					2			3		
2				2			1			3			2		1
3							2	1				1	2		
4					3		1			2			2		
5	1		1	2								1	2		1
6				2									1		1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Fundamentals of Digital Manufacturing Science- Zude Zhou, Shane (Shengquan) Xie, Dejun Chen - Springer
2. Practical Guide to Digital Manufacturing- Wen-Jun Chris Zhang - Springer

REFERENCE BOOKS:

1. Digital Manufacturing and Assembly Systems in Industry 4.0- Divya Zindani, J. Paulo Davim, Kaushik Kumar- CRC Press
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Second Edition, MIT Press, 2017
3. Embedded Systems ARM® Programming and Optimization-Jason D. Bakos-an imprint of Elsevier--textbooks.elsevier.com/9780128003428

E Books / MOOCs/ NPTEL

1. Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things- Peter Marwedel-Springer - https://doi.org/10.1007/978-3-030-60910-8
2. Embedded System Design with Arm Cortex-M Microcontroller-Cem Ünsalan • Hüseyin Deniz Gürhan Mehmet Erkin Yüce- https://doi.org/10.1007/978-3-030-88439-0
3. Embedded, Cyber-Physical, and IoT Systems--Embedded, Cyber-Physical, and IoT Systems: Essays Dedicated to Marilyn Wolf on the Occasion of Her 60th Birthday | SpringerLink

Composite Materials Technology

Course Code:	**ME2332-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1007-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Student should be able to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2.	Students should apply Non-conventional composites materials depends on application and determine stresses and strains relation in composites materials.
3.	Student should apply constitutive equations of composite materials and understand mechanical behavior at micro level.
4.	Student should be able to describe fundamental fabrication processes for polymer matrix, metal matrix, and ceramic matrix composites.
5.	Student should be able to use the ideas developed in the analysis of composites towards using composites in Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment .

UNIT-I

08 Hours

Introduction to Composite Materials: Definition, classification & brief history of composite materials.
Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers.
Reinforcements: Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of **Fibers Matrix Materials:** Polymers, Metals and Ceramic Matrix Materials.
Interfaces: Wettability, Crystallographic nature of interface, types of bonding at the interface and optimum interfacial bond strength.

07 Hours

Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Moulding Compound and carbon reinforced polymer composites. Interfaces in PMC's, Structure & Properties of PMC's,
Applications Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing, Interfaces in Metal Matrix Composites, Properties & Applications.

UNIT-II

07 Hours

Nonconventional Composites: Introduction, Nanocomposites; Polymer clay nanocomposites, self healing composites, self-reinforced composites. Biocomposites, Laminates; Ceramic Laminates, Hybrid Composites.
Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength. **Fatigue Properties;** Tension-Tension Fatigue, Flexural Fatigue.
Impact Properties; Charpy, Izod, and Drop-Weight Impact Test.

07 Hours

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.

UNIT-III

Manufacturing: Layup and curing - open and closed mould processing, Hand lay up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding,	**06 Hours**
Application Developments: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment	**05 Hours**

Course Outcomes: At the end of the course student will be able to

1.	**Use** different types of manufacturing processes in the preparation of composite materials
2.	**Identify** the use of Non-conventional composites materials.
3.	**Determine** stresses and strains relation in composites materials.
4.	**Derive** four elastic moduli of the composite lamina to solve numerical problems associated with micro lamina.
5.	**Explain** different techniques for manufacturing and fabrication of composite materials and **Explain** application of composite material in engineering sectors.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2332-1.1	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME2332-1.2	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME2332-1.3	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME2332-1.4	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
ME2332-1.5	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Composite Material Science and Engineering Krishan K. Chawla Springer Third Edition First Indian Reprint 2015
2.	Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.
3.	Mechanics of composite materials, Autar K. Kaw CRC Press New York.

REFERENCE BOOKS:

1.	Mechanics of Composite Materials & Structures Madhijit Mukhopadhay Universities Press 2004
2.	Fibre-Reinforced Composites, Materials, Manufacturing, and Design P.K. Mallick CRC Press, Taylor & Francis Group Third Edition

FOUNDRY TECHNOLOGY

Course Code:	**ME2333-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the different metallurgical aspects of consideration during casting design

2.	Review the fundamentals of solidification and understand the different melting technologies.
3.	Analyze the design concepts in gating systems in foundry and understand the special molding techniques used in foundry.
4.	Understand the casting properties of important ferrous/ nonferrous materials and identify the difficulties in casting these alloys.
5.	Identify the need for modernization and mechanization of foundries.

UNIT-I	
Foundry Metallurgy: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals. Casting design: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost.	**08 Hours**
Solidification of castings: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Coring and segregation. Concept of progressive and directional solidification, Solidification time and Chvorinov's rule. Structure of castings - refinement and modification of cast structure **Melting Furnaces:** Introduction to various types of furnaces. Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, cokeless cupola, cupola charge calculations.	**08 Hours**
UNIT-II	
Risering and Gating: Need for risering, general considerations of risering, riser types, riser size and location. Requirements of a riser. Sand, insulating, and exothermic materials used for risers. Riser feeding distance and theory of risering. Riser efficiency,methods to improve riser efficiency. Gating system – Classification, theoretical consideration of gating, laws of fluid flow, turbulence in gating system, need for tapered sprue, gating ratio(simple problems). Special Moulding Techniques: Principles, materials used, process details and application of no-bake sand systems, vacuum moulding, flaskless moulding, and high pressure moulding.	**08 Hours**
Ferrous Foundry: Melting procedures, casting characteristics, production, specification, and properties of some typical steels, grey cast iron, malleable iron, and spheroidal graphite cast iron castings. **Non-Ferrous Foundry:** Melting procedures, casting characteristics, production, specification, and properties of some typical aluminum, copper, and magnesium based alloy castings.	**08 Hours**
UNIT-III	
Modernization and mechanization of foundry: Need for modernization, and mechanization, moulding and core making, melting, pouring, shake out equipment and fettling, dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. Pollution control.	**08 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Identify the possible defects in the casting and suggest measures to reduce it. Suggest a Design to produce a casting in line with the thermal stress, metal flow, safety and economic aspects.
2.	Describe solidification phenomenon in castings and suggest suitable melting processes to melt ferrous and nonferrous material. Calculate the cupola charge to meet the required specification of casting

3.	Illustrate necessary gating criterions to produce fault free molding and select advanced molding techniques for producing high quality castings aiming at meeting the newer requirements such as higher productivity, mold finishing and faster production rate.
4.	Distinguish between metallurgical and production aspects of ferrous and nonferrous foundries and indicate necessary changes to be made in the manufacturing technique.
5.	Identify the needs for mechanization of foundry industries and analyse the impact of conventional foundry on human health and safety as per regulations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2333-1.1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**
ME2333-1.2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
ME2333-1.3	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**
ME2333-1.4	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
ME2333-1.5	**3**	**1**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Principles of metal casting, Heine Loper & Rosenthal TMH - 2005
2.	Principle of Foundry Technology, P. L. Jain, TMH – 2006.

REFERENCE BOOKS:

1.	Castings, John Campbell, Second edition, Elseivier, 2004
2.	Foundry Technology, P. N. Rao, 2009
3.	Manufacturing Process, I, Dr. K. Radha Krishna 5PthP Edn. Sapna Book House, Bangalore, 2009
4.	Foundry Technology, O.P.Khanna. Dhanpat Rai Publications. 2011

E Books / MOOCs/ NPTEL

1.	NOC:Principles of Casting Technology, IIT Roorkee, Dr. Pradeep K. Jha https://nptel.ac.in/courses/112107215

Non-Destructive Testing

Course Code:	**ME2334-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Outline the benefits obtained from NDT and describe the principles of Liquid Penetrant Inspection, Magnetic Particle Inspection.
2.	Describe the principles of Eddy Current Inspection, Computed Tomography and Thermal inspection
3.	Explain Ultrasonic Inspection with major variables in ultrasonic inspection and summarize various ultrasonic waves
4.	Describe the principles of Radiographic Inspection, Electron radiography, Neutron radiography, Xeroradiography and summarize application of radiographic inspection in industry.
5	Explain the principles Acoustic Emission Inspection and summarize the AE sensors and preamplifiers, instrumentation principles, applications of AEI.

UNIT-I

Introduction to Non-Destructive Testing:	**08 Hours**
Selection of NDT methods, Various distinct areas of NDT, Visual Inspection: equipment's used for visual inspection and applications, Leak testing – brief introduction, Liquid Penetrant Inspection – principle, advantages, limitations and applications, Magnetic Particle Inspection – methods of generating magnetic fields, types of magnetic particles, suspending liquids, steps in inspection, advantages, limitations, and applications.	
Eddy Current Inspection	**09 Hours**
Principle, operation, operating variables, procedure, inspection coils, detectable discontinuities, advantages, and limitations and applications of E.C.I. Thermal inspection: Introduction, principles, Thermal inspection methods, equipment's, techniques, and applications	
UNIT-II	
Ultrasonic Inspection	**06 Hours**
Basic equipment, advantages, limitations, applications, characteristics of ultrasonic waves, major variables in ultrasonic inspection,.	
Basic Inspection Methods	**04 Hours**
Pulse echo, transmission, transducer elements, couplants, search units, inspection standards	
Radiographic Inspection	**04 Hours**
Principles, limitations, radiation sources – X rays, γ rays, recording media, film types and selection, interpretation of radiographs, image quality, penetrometers.	
UNIT-III	
Acoustic Emission Inspection	**05 Hours**
Principle, comparison of AE with other inspection methods, applications, AE waves and propagation, AE sensors and preamplifiers, instrumentation principles, applications.	
Multi-channel acoustic emission system	**04 Hours**
Use of AE Inspection in Production Quality Control and Metal Pressure Vessels and Storage Tanks, AEI applications research activities.	

Course Outcomes: At the end of the course student will be able to

1.	Describe the benefits of NDT over conventional methods. Illustrate the principles of Liquid Penetrant Inspection and Magnetic Particle Inspection to detect the cracks in steels
2.	Describe the principles of Eddy Current Inspection and Thermal inspection understanding its various applications
3.	Illustrate the principle of Ultrasonic Inspection technique, set-up and operation. Demonstrate the benefits of UT over other techniques for a given sample
4.	4 Illustrate the principles of Radiographic Inspection, and their applications. Interpet the radiography results of a given film of samples.
5.	Describe the principles of Acoustic Emission Inspection and analyse benefits and applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2334-1.1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME2334-1.2	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME2334-1.3	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME2334-1.4	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
ME2334-1.5	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**3**
1: Low 2: Medium 3: High															

TEXTBOOKS:

1. NDE and Quality Control, Vo.17, ASM Hand book, 9th Edition, 1989

REFERENCE BOOKS:

1.	Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishers
2.	Non Destructive Test and Evaluation of Materials, J.Prasad and C G K Nair, Tata McGraw Hill
E Books / MOOCs/ NPTEL	
1.	https://www.nde-ed.org
2.	https://www.youtube.com/channel/UCu4t0F_NiCcmfgRXZuHmW9Q/video

NON-TRADITIONAL MACHINING

Course Code:	**ME2335-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To understand about non-traditional machining process, its need and importance in manufacturing.
2.	To know how to machine hard and tough materials by using thermo-electric energy like plasma, laser and electron beam.
3.	To understand how to machine brittle and soft materials by applying mechanical energy using abrasives in combination of ultrasonic energy or pressurized fluids like gas and liquids.
4.	To know how to fabricate tools and dies which are made-up of hard materials using electric discharge energy.
5.	Get an idea of how electro-chemical & chemical energy is used to machine hard, tough and brittle materials with high metal removal rate.

UNIT-I

Introduction & Plasma Arc Machining (PAM)	**07 Hours**

Introduction, Classification, Comparison with traditional machining, Need of NTM, Process selection and applications.
PAM: Introduction, Plasma generation, Machining Principle, Mechanism of Metal Removal Rate, Parameters, Plasma torch- Mode of operation, types and design of torch, Selection of gas, Process Characteristics, Working Environment & Safety precautions, Applications, Advantages & Limitations.

Laser Beam Machining (LBM) & Electron Beam Machining (EBM)	**09 Hours**

LBM: Introduction, Laser Generation- Solid state pulse laser and CO_2 gas laser, Equipment's, Machining Principle, Process Characteristics, Applications, Advantages & Limitations.
EBM: Introduction, Machining Principle & Equipment's, Process Characteristics, Application, Advantages & Limitations.

UNIT-II

Electrochemical Machining (ECM)	**06 Hours**

Introduction, Machine setup, Electrolyte and its system, Process Characteristics, Process Capability, Types of tools, Tool and Insulation materials, Tool size, Handling of Slug.

Applications of ECM	**04 Hours**

Applications- Cavity Sinking, Drilling & Trepanning, Electro-Chemical turning, Electro-Chemical Sawing & Cutting, Electro- Chemical honing, Electro-Chemical Deburring and Electro-Chemical Grinding, Economics of ECM, Advantages & Limitations.

Electrical Discharge Machining (EDM):	**04 Hours**

Introduction, Machine setup, Dielectric Fluid, Generators, Electrode feed control, Tools used, Flushing, Process Characteristics.

UNIT-III

EDM Applications & Chemical Machining (CHM):	**05 Hours**
EDM Applications, Electric Discharge Grinding, Wire EDM, Advantages & Limitations. CHM: Introduction, CHM Technique, Classification, Maskant. Chemical Blanking: Process steps, Process Characteristics.	
CHM Applications	**05 Hours**
Applications, Advantages & Limitations. Chemical Milling: Process steps, Process Characteristics, Applications, Advantages & Limitations.	

Course Outcomes: At the end of the course student will be able to

1.	Apply the engineering knowledge and analyze to get solutions to the machining problem.
2.	Conduct investigation on the machining problem and use modern tools in machining for the benefit of society.
3.	Understand the machine cutting technology on environment and use the technology with ethics responsibly.
4.	Apply the process individually and also as team with efficient communication between them.
5.	Manage & use the process efficiently and also financially and also provides the opportunity to improvement.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2335-1.1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**2**	**2**	**2**	**3**	**3**	**3**	**-**
ME2335-1.2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**-**
ME2335-1.3	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**3**	**2**	**3**	**3**	**-**
ME2335-1.4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**2**	**2**	**2**	**3**	**3**	**3**	**-**
ME2335-1.5	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Modern machining process, Pandey and Shah, Tata McGraw Hill 2000.
2.	Production Technology: HMT Tata McGraw Hill 2001.

REFERENCE BOOKS:

1.	Non-Conventional Machining, P.K. Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House 2005.
2.	Metals Handbook: Machining- Volume 16.
3.	Nontraditional Machining Processes, E. Weller, Society of Manufacturing, 2 Sub edition (1984).

E Books / MOOCs/ NPTEL

1.	https://link.springer.com/book/10.1007/978-1-4471-5179-1.
2.	https://www.goodreads.com/book/show/38725935-non-traditional-machining-processes.
3.	https://archive.nptel.ac.in/courses/112/105/112105212.

CAD / CAM

Course Code:	**ME2233-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Able to understand the application of computers in design and manufacturing.
2.	Understand the concepts for generation of lines and curves
3.	Able to understand the surfaces and solid modelling concepts and develop simple models
4.	Understand the concepts of NC , CNC machines and their roles in industries
5	Able to understand role of computers and recent developments in the manufacturing sector.

UNIT-I	
Introduction	**08 Hours**
Product Cycle, Definition of CAD and CAM, use of computers in product cycle, Conventional design process, computer aided design, benefits of CAD. Advantages and disadvantages of CAD, ethics in CAD/CAM. Introduction to virtual reality, Ethics in CAD/CAM.	
Hardware	**09 Hours**
Hardware for CAD: Graphic displays – Image generation techniques, Direct beam refresh, Direct view storage, Raster scan, LED, LCD monitors, Display controller & display memory. Introduction to exchange of modelling data – Basic features of IGES, STEP, DXF, and DMIS. Graphics software: Transformations 2-D – Translation, Rotation and Scaling, Reflection Geometric modelling: Algorithm for generation and display of simple graphical elements like lines, circle, ellipse. Types and representation of curves: Synthetic curves – Cubic, Bezier & B-spline curves	
UNIT-II	
Geometric surfaces and solid modelling:	**06 Hours**
Geometric surfaces and solid modelling: Types and representation of surfaces: Analytic surfaces – Plane, ruled, revolution and tabulated surfaces. Synthetic surfaces – cubic, Bezier and B-spline surfaces Types and representation of solids – Solid representation, half spaces, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG). NC, CNC and Adaptive control system	
	04 Hours
Basic components of NC, NC procedure, Classifications of NC, Machining centres, advantages and disadvantages of NC, Problems with Conventional NC, Introduction to CNC, Functions of CNC, CNC part programming on turning and milling operations. Open CNC.	
	04 Hours
Adaptive control optimization, Adaptive control constraint, ACC for turning, Adaptive control of grinding, optimization strategy	
UNIT-III	
Group Technology & Flexible Manufacturing:	**05 Hours**
Part families, Part Classification & coding, Machine cell design & benefit of GT, FMS workstations, planning the FMS, FMS layout configuration.	
	04 Hours
Analysis method, application and benefit of FMS. Shop floor control, Functions, Shop floor control system	

Course Outcomes: At the end of the course student will be able to

1.	Summarize the importance of computers in design and Manufacturing. Describe hardware components such as graphic display terminals, LED, LCD and display controller in Computers. Apply graphic transformation techniques to solve 2-D elements problems.
2.	Solve simple problems based on the knowledge of graphical elements (Line, circle, ellipse) and curves
3.	Formulate mathematical equations for parametric and non-parametric representation of surfaces (analytic & synthetic surfaces). Discuss geometric modelling techniques (Half-space, B-rep, Solid modelling).
4.	Develop simple programmes for machining operations using the fundamentals of NC, CNC, DNC, Adaptive control systems

5.	Explain group technology and FMS techniques of computer aided manufacturing and discuss the role and importance of computers in the manufacturing environment

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
ME2233-1.1	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**2**
ME2233-1.2	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**	**-**	**2**
ME2233-1.3	**1**	**3**	**2**	**2**	**2**	**-**	**-**	**1**	**2**	**2**	**-**	**1**	**2**	**-**	**2**
ME2233-1.4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**1**	**3**	**2**	**-**	**1**	**1**	**-**	**3**
ME2233-1.5	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**1**	**2**	**2**	**-**	**1**	**1**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Groover Mikell P. and Zimmers Emory W.(2003) "Computer aided design and manufacturing" Prentice Hall of India , New Delhi.
2.	KorenYoram and Ben and Uri Joseph (2005) "Numerical Control of Machine Tools"Khanna Publishers, New Delhi.
3.	Zienkiewicz O.C. (1977) "The Finite Element Method" Tata McGraw Hill New Delhi
4	Computer control of Manufacturing System YoramKoren McGraw Hill Intl.Pub.2002

REFERENCE BOOKS:

1.	Ibrahim K Zeid (1998) "CAD/CAM Theory and Practice" Tata McGraw Hill New Delhi
2.	Daryl L Logan (2003) "A First Course in Finite Element Method" Pearson Education New Delhi
3.	Newman W. and R. Sproull(2005) "Interactive Computer graphics" Tata McGraw Hill New Delhi
4.	MikellGroover P., Mitchell Weiss, Roger Nagel N. and Nicholas Odrey G. (1986) "Industrial Robotics Technology, Programming and Applications" McGraw-Hill Inc, Singapore
5	Mechatronics, HMT Ltd., Tata MaGraw Hill Pub.2000
6	Vince, John (2004), Introduction to Virtual Reality Authors: Vince, Springer-Verlag London

E Books / MOOCs/ NPTEL

1.	1. http://nptel.ac.in/courses/112102101

Fluid Power Systems

Course Code:	**ME2234-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1005-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To understand the basic concept of Fluid power system and to apply Pascal's law.
2.	To understand the construction and working principle of hydraulic pumps and motors.
3.	To understand the construction and working principle of control valves.
4.	To design and draw the hydraulic circuits for various applications of hydraulic system.
5	To understand the working principle of various parts of pneumatic system and to draw simple pneumatic circuits

UNIT-I

Hydraulic system:	**08 Hours**

Hydraulic system: - Basic structure of hydraulic control system. Hydraulic fluids: function, properties and types of fluids. Filters, sealing devices, accumulators.
Hydraulic Pumps: Classification, principle of working & constructional details of vane pump, gear pumps, radial & axial piston pumps, pump selection parameters, Power and efficiency calculations (pump performance).

Hydraulic Actuators:	**09 Hours**

Hydraulic Actuators: Rotary actuators (Hydraulic motors): Type and constructional features of vane, gear, axial piston, & radial piston. Numerical problems on performance of motor. Linear actuators (hydraulic cylinder): Types of cylinder and constructional features of single acting, double acting, tandem, telescopic and end cushioning cylinder, mechanics of cylinder loading, calculations of piston velocity, power, efficiency. Intensifier and its application.

UNIT-II

Hydraulic control valves :	**06 Hours**

Necessity of pressure control, directional control, flow control valves, DIRECTION CONTROL VALVES : Classification and constructional features. DESIGN OF.

04 Hours

PRESSURE CONTROL VALVE: : Classification and constructional features.
FLOW CONTROL VALVES: : Classification and constructional features

04 Hours

HYDRAULIC CIRCUITS: Introduction to hydraulic circuit. Design and simulation of single acting and double acting cylinder actuation, Circuit illustrating use of different types of direction control valve, pressure control valve and flow control valve. Double pump circuit, Regenerative circuit, synchronization circuit, safety circuit, Intensifier circuit, accumulator circuits

UNIT-III

PNEUMATIC SYSTEM	**05 Hours**

Introduction to Fluid power, its advantages and applications, Pascal's Law and numerical problems on Pascal's Law. Introduction to pneumatic system, Comparison of Pneumatics with Hydraulic power transmission, Properties of air, gas laws.

04 Hours

Basic structure of pneumatic system, classification and working of air compressor. Air dryer, Filter, Regulators & Lubricators. Linear and rotary actuators. Pressure regulating valves, Directional control valves, Flow control valves, logic valves, quick exhaust valve, time delay valve. Design and simulation of simple Pneumatic circuits

Course Outcomes: At the end of the course student will be able to

1.	Illustrate Pascal's law with real life examples of Fluid Power systems and calculate required parameters. Explain the construction and working of hydraulic pumps. Calculate the parameters and performance of hydraulic pumps for given conditions
2.	Explain the construction and working of hydraulic actuators. Calculate the parameters and performance of hydraulic actuators for given conditions
3.	Explain the construction and working of control valves using hydraulic symbols
4.	Develop the hydraulic circuits for given applications using hydraulic symbols
5.	Explain the construction and working of pneumatic system elements using hydraulic symbols. Develop the pneumatic circuits for given applications using pneumatic symbols

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2234-1.1	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME2234-1.2	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**
ME2234-1.3	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**-**	**-**
ME2234-1.4	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**

ME2234-1.5	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**-**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Fluid Power with application's - Anthony Esposito, Fifth edition, Pearson Education, Inc 2007.
2.	Hydraulic and Pneumatic controls by R Srinivasan, Tata McGHraw Hill Publishing, 2011,Second edition.
3.	Oil Hydraulic systems – Principles and Maintenance - S.R. Majumdar, Tata McGraw Hill Publishing Company Ltd. 2001.
4	Pneumatic systems - S. R Majumdar, Tata McGHraw Hill Publishing Co. – 2005

REFERENCE BOOKS:

1.	Pneumatics Basic Level TP 101- by Peter Croser & Frank Ebel, Festo Didactic publication - 1999.
2.	Fundamentals of Pneumatic Control Engineering - J P Hasebrink & R Kobbler, Festo Didactic publication, 3PrdP edition – 1989.
3.	Pneumatic Control for Industrial Automation - Peter Rohner & Gordon Smith, John Wiley Sons publication – 1989
4.	Power Hydraulics - Michael J Pinches & John G Ashby, Prentice Hall – 1989

Professional Elective Courses (Thermal Stream)

Energy Management

Course Code:	**ME1241-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Know fossil fuel reserves in India, energy requirements in future, the need for energy conservation and management and various energy conservation methods.
2.	Understand the concept of energy auditing, duties and responsibilities of energy manager
3.	Understand waste heat recovery and cogeneration concepts.
4.	Understand the principal pollutants due to domestic, transport and industries, greenhouse effect, acid rain, global warming.
5.	To know about Kyoto protocol, carbon trading, carbon fund, energy rating, green rating.

UNIT-I

Introduction — **15 Hours**

Classification of energy sources, Indian energy scenario with respect to commercial sources.
Energy efficiency benefits, methods of energy conservation, simple energy conservation methods applicable to domestic, transport, agricultural and industrial sectors.
Energy Management: Definition, objectives, Organizing energy management in Industries. Organizational set up for energy management, Functions of energy manager.
Energy Audit: Elements and concepts, Types of energy audits, Instruments used in energy auditing.

UNIT-II

Boiler and Furnace — **15 Hours**

Boiler and Furnace Audit, Efficient use of steam in boiler distribution system.
Waste Heat Recovery: Potential, benefits, waste heat recovery equipments -recuperators, heat wheels, heat pipe, waste heat boilers, heat pumps.
Cogeneration: types of cogeneration systems.

UNIT-III

Principal pollutants — **10 Hours**

Principal pollutants due to domestic, transport and industries , greenhouse effect, acid rain, global warming, Kyoto protocol, carbon trading, carbon fund, energy rating, green rating.

Course Outcomes: At the end of the course student will be able to

1.	Classify energy sources. Describe the Indian energy scenario and calculate the lifetime of the availability of the reserves. Explain the no cost/low cost energy conservation methods applicable to domestic, transport, agricultural and industrial sectors.
2.	Illustrate energy management and energy audit and conduct mini energy audit for domestic appliances and lighting in industries. Explain the duties and responsibilities of energy manager
3.	Analyze the energy losses in boilers and furnaces, list low cost conservation methods in boilers and furnaces and explain the utilization of steam efficiently in boiler houses and compute the quantity of flash steam and heat content recovered
4.	Explain waste heat recovery and cogeneration and compute cogeneration efficiency
5.	Outline the major air pollutants and explain greenhouse effect, acid rain, kyoto protocol, carbon trading, energy rating, and green rating.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3

ME1241-1.1	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**1**
ME1241-1.2	**3**	**3**	**-**	**-**	**-**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**3**	**1**
ME1241-1.3	**3**	**3**	**-**	**-**	**-**	**2**	**3**	**1**	**1**	**1**	**-**	**1**	**1**	**3**	**1**
ME1241-1.4	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**3**	**1**
ME1241-1.5	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**3**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Energy management, WR Murphy and G Mc Kay Oxford university Press(2009)
2. Energy Management Handbook - 7th Edition - Wayne C. Turner , Steve Doty , Wayne C. Truner 2009

REFERENCE BOOKS:

1. Design and Management for energy conservation by Callaghn P W , Pergamon, oxford ,1981
2. Energy conservation in Process Industry—W.F.Kenny(1984)
3. Energy Engineering and Management- Amlan Chakrabarti-Prentice hall India 2011
4. Energy Management Principles C Smith-Pergamon Press,New York 1981

E Books / MOOCs/ NPTEL

1. https://beeindia.gov.in/
2. https://en.wikipedia.org/wiki/Bureau_of_Energy_Efficiency

Wind & Solar Power Engineering

Course Code:	**ME2241-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1. Measure, estimate and predict the solar radiation at the given location.
2. Demonstrate different application of solar energy such as cooking, drying, cooling, power generation.
3. Design and suggest the photo voltaic cell for an application.
4. Estimate the parameters of wind energy and suggest it for applications.
5. Design the blade, suggest orientation system and regulating devices in wind turbine

UNIT-I

Solar Radiation	**15 Hours**

Solar Radiation - Empirical Equations - Solar Chart - Measurements of Solar Radiation and Sunshine – Solar Radiation Data
Solar Thermal Collectors - Flat Plate and Concentrating Collectors - Solar Heating and Cooling Techniques - Solar Desalination - Solar Pond - Industrial Process Heat – Solar Thermal Power Plant - Solar Thermal Energy Storage

UNIT-II

Photo voltaic	**15 Hours**

Introduction - Fundamentals of photo Voltaic Conversion - Solar Cells - PV Systems – PV, Applications Wind Data and Energy Estimation - Wind Energy Conversion Systems - Wind Energy Collectors and its Performance - Wind Energy Storage - Applications of Wind Energy - Safety and Environmental Aspects

UNIT-III

Design of blade	**10 Hours**

Design of blade: Aerodynamic configuration of rotor and determination of blade structure. Orientation system and regulating devices. Description of vertical axis wind mills. Use of wind mill for water pumping.

Course Outcomes: At the end of the course student will be able to

1.	Estimate solar radiation at the given location and explain solar radiation measurement devices
2.	Describe the use of solar thermal energy for domestic and industrial applications
3.	Describe the fundamentals of photovoltaic energy conversion and its applications. Explain steps involved in fabrication of photovoltaic cells
4.	Describe the working of wind data measurement devices. Explain construction and functioning of horizontal axis wind turbine
5.	Design wind turbine blades. Describe regulating and orientation devices for wind turbines

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2241-1.1	**1**	**2**	**3**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**-**
ME2241-1.2	**3**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**-**
ME2241-1.3	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**2**	**-**	**3**	**-**
ME2241-1.4	**3**	**2**	-	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**2**	**-**
ME2241-1.5	**1**	**2**	**3**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**3**	**-**
1: Low 2: Medium 3: High															

TEXTBOOKS:

1.	WS.P. Suknofme, " Solar Energy Principle of Thermal Collection and Storage ", (1997), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
2.	G.D.Rai, " Non Conventional Energy Sources ", (1999), Khanna Publishers, New Delhi.
3.	

REFERENCE BOOKS:

1.	H.P.Garg and J.Prakash, " Solar Energy, Fundamentals and Applications " (1997), Tata McGraw Hill Publishing Company Ltd., New Delhi
2.	B.S.Magal, " Solar Power Engineering " (1993), Tata McGraw Hill Publishing Company Ltd., New Delhi.
3.	J.R.Howell, R.B.Bannerot and G.C.Vtiet, " Solar Thermal Systems ", (1982), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
4.	J.A.Duffie and W.A.Beckman, " Solar Engineering of Thermal Process " (1991), John Wiley,New York
5	Golding E.W. " The Generation of Electricity by Wind Power ", (1976), E and F N Spon Ltd.,London.
6	. Le Gourieres D., " Wind Power Plant, Theory and Design ", (1982), Pergamon Press, France

E Books / MOOCs/ NPTEL

1.	https://www.youtube.com/watch?v=RqppRC37OgI
2.	https://youtu.be/BTyJrRy8DUE

COMPUTATIONAL FLUID DYNAMICS

Course Code:	**ME3241-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1104-1,ME1005-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the basic concepts of computational dynamics and a brief solution procedure.
2.	Derive the equations related to turbulent flows and understand various discretization methods.
3.	Understand the solution obtained by CFD.
4.	Know the areas where CFD is applicable.
5.	Know the application of CFD to multiphase systems and fluid structure interaction.

UNIT-I	
INTRODUCTION: Computational Fluid Dynamics, Advantages, Applications, Future of CFD. CFD	**08 Hours**
SOLUTION PROCEDURE: Problem set up-pre-process, Numerical solution – CFD solver, Result report and visualization-post-process. **EQUATIONS FOR CFD:** Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions.	**09 Hours**
UNIT-II	
CFD TECHNIQUES: Introduction, Discretization of governing equations, Finite difference method, Finite volume method, converting governing equations to algebraic equation system, Numerical solutions.	**06 Hours**
CFD SOLUTION ANALYSIS: Introduction, consistency, stability, convergence, accuracy, efficiency, case studies. **PRACTICAL GUIDELINES FOR CFD:** Introduction, grid generation, boundary conditions, turbulent modeling.	**08 Hours**
UNIT-III	
APPLICATIONS OF CFD: Introduction, CFD as a design tool, indoor air flow distribution, CFD as a research tool, CFD applied to heat transfer coupled with fluid flow, buoyant free standing fire, flow over vehicle platoon, air/particle flow in human nasal cavity, high speed flows.	**05 Hours**
ADVANCED TOPICS IN CFD: Introduction, advances in numerical methods and techniques – incompressible flows, compressible flows, moving grids, multigrid methods, parallel computing, immersed boundary methods. Advances in computational methods – DNS, LES, RANS-LES coupling for turbulent flows, multiphase flows, combustion, fluidstructure interaction, physiological fluid dynamics and other numerical approaches.	**04 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain the Basic theory of computational fluid dynamics. Discuss the equations of CFD and application of CFD in industrial application.
2.	Determine the optimized parameters to achieve stability, convergence, accuracy and efficiency of mechanical systems.
3.	Identify and solve convergence and non convergence problems.
4.	Explain the working principle of CFD algorithm and discuss its applications.
5.	Explain the concept of RANS,DNS,LES. Discuss simplex and semi implicit CFD programming methods

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
ME3241-1.1	**3**	**1**	**1**	**-**		**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**2**	**-**
ME3241-1.2	**1**	**3**	**2**	**-**		**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**2**	**-**
ME3241-1.3	**3**	**2**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**2**	**-**
ME3241-1.4	**3**	**1**	**1**	**-**		**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**2**	**-**
ME3241-1.5	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Computational Fluid Dynamic – a practical approach, Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, Butterworth-Heinemann (ELSEVIER), 2008

REFERENCE BOOKS:

1.	An introduction to CFD, H. Versteeg and W. Malalasekra, Pearson, Education, 2 nd Edition, 2008.

RENEWABLE SOURCES OF ENERGY

Course Code:	**ME1341-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Identify different sources of Renewable energies and their possible use for the welfare of the Mankind
2.	Study the Conversion technologies, pros and cons, and application of solar energy
3.	Study the Conversion technologies, pros and cons, and application of biomass energy & wind energy
4.	Study the Conversion technologies, pros and cons, and application of ocean energy, tidal energy & wave energy
5.	Study the Conversion technologies, pros and cons, and application of geothermal energy and types of fuel cells

UNIT-I

Energy sources- Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources;

Solar energy: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

Principle of Conversion of Solar Radiation into Heat

•Flat Plate Collectors (Liquid flat plate collector), Effect of various parameters on the performance, testing procedure.

•Concentrating collectors – Introduction, cylindrical, parabolic collector, Compound parabolic collector, Central receiver collector.

08 Hours

Solar thermal applications - Solar pond, Solar Air heater, Solar Water heater, solar power generation, solar space cooling and refrigerator, solar distillation, solar drying, solar cooking, solar pumping, solar furnace. Solar photo Volatics.

Solar thermal energy storage – Introduction, Sensible, Latent and thermo Chemical storage, numerical problems

08 Hours

UNIT-II	
Biomass Energy- Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Biomass Gasification, Biomass to Ethanol Production, Biogas production, factors affecting biogas generation, types of biogas plants Wind Energy: Introduction, Power of wind energy, conversion systems, and types of wind machines, performance of wind machines with numerical problems, applications and prospects in India	**07 Hours**
Tidal Power- Introduction, causes for tide formation, power of tide, numerical problems tidal power plants, advantages and limitations. Ocean Thermal Energy – Introduction to O.T.E.C., open and closed cycle OTEC systems, prospects in India. Wave Energy– Introduction, power of wave energy, numerical problems, and conversion devices	**08 Hours**
UNIT-III	
Geothermal Energy- Introduction, types of geothermal resources, methods of harnessing, geothermal energy applications, environmental problems and prospects in India. 3 Hours Fuel Cells - Introduction, Principle and operation of fuel cells, classification and types of fuel. Fuel for fuel cells, performance characteristics of fuel cells, application of fuel cells Energy	**09 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain solar physics and calculate solar energy radiation. Explain the solar energy collectors and methodologies of storing solar energy.
2.	Explain the applications of solar energy and methods of solar energy storage. Determine the amount of energy storage and volume of storage required.
3.	Explain the methods of wind energy and biomass energy conversion techniques. Determine power available in the wind and maximum amount of energy extracted from the wind. Determine the size of the biomass digester.
4.	Explain OTEC, tides and waves methods of harvesting energy from the ocean. Determine the energy from tides and waves..
5.	Explain the methods of utilising energy from geothermal resources.and types of fuel cells.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1341-1.1	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**-**
ME1341-1.2	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**-**
ME1341-1.3	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**3**	**-**
ME1341-1.4	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**-**
ME1341-1.5	**3**	**1**	**-**	**-**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill. 2008
2.	Solar Energy utilization by G.D. Rai Khanna Publishers. 2004
3	Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers. 2011

REFERENCE BOOKS:

1.	Power Plant Engineering by Arora, Domkundwar. Dhanpat Rai & Sons. 1999

2.	Energy Technology (Non Conventional& Conventional) by S. Rao, Dr. B.B.Parulekar Khanna Publishers, third edition 2013

Gas Propulsion and Aerodynamics

Course Code:	**ME2341-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: mechanical Engineering

Course Objectives:

1.This course will present gas and aerospace propulsive devices as systems, with functional requirements and engineering and environmental limitations along with requirements and limitations that constrain design choices also mission analysis, fundamental performance relations, and exemplary design solutions are presented. The course also
2.Imparts knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.

UNIT-I

BASIC CONCEPTS AND ISENTROPIC FLOWS	**14 Hours**

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers –Use of Gas tables.

UNIT-II

THEORY OF JET & SPACE PROPULSION	**14 Hours**

Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors. Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

UNIT-III

Introduction to Aerodynamics	**12 Hours**

Atmosphere (lSA) and its stability Continuum hypothesis, dynamic similarity, Aero foil nomenclature, forces and moments Incompressible irrotational flow, Complex potential, Singularities and superposition, Blasius theorem, Method of images Circulation, Robins Magnus effect and Kutta .Joukowski theoremConformal Mapping and Joukowski air foil.

Course Outcomes: At the end of the course student will be able to

1.	To design and develop efficient and economical propulsion systems
2.	To describe Effect of Mach number on compressibility & Carry out preliminary designs of rocket or air breathing propulsion systems to meet specified requirements.
3.	To illustrate issues with jet crossing higher Mach numbers and to assess the stability Continuum hypothesis, dynamic similarity
4	To examine and draw Aero foil nomenclature for different aircrafts
5	To investigate forces and moments forces and moments acting aerodynamically on the aircrafts.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	

↓ Course Outcomes													1	2	3
ME2341-1.1	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**
ME2341-1.2	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**
ME2341-1.3	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**
ME2341-1.4	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**
ME2341-1.5	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. The dynamics and thermodynamics of compressible flows: A. H Shapiro, John Wileyand Sons.
2. Hill P and Peterson C, " Mechanics and Thermodynamics of Propulsion ", Addison Wesley Publishing Company, 1992.
3. Ganesan V, Gas Turbines, Tata McGraw-Hill Publishing Company Ltd., 2003.

REFERENCE BOOKS:

1. Yahya S M " Fundamentals of Compressible Flow ", New Age International (P) Limited, New Delhi, 1996.

E Books / MOOCs/ NPTEL

1. https://archive.nptel.ac.in/courses/101/101/101101002/
2. https://www.iitk.ac.in/aero/courses
3. https://ocw.mit.edu/courses/16-50-introduction-to-propulsion-systems-spring-2012/pages/syllabus/

Power Plant Engineering

Course Code:	**ME2242-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1. Understand the different types of fuels used for steam generation. Explain different types of equipment for burning coal in steam power plants. Know the methods of coal and ash handling in steam power plant.
2. Understand the working of high-pressure steam generators. Explain Working of Chimneys. Cooling towers and ponds used in steam power plant. Calculate the height of Chimneys required for the steam power plant
3. Explain the working, applications and various components of Diesel Engine power plant. Understand the importance of hydrology. Explain the working and application of hydro-electric power plant
4. Explain the working of the gas turbine plant and its parts. Explain the working and components of nuclear power plant. Know the waste disposal methods used in nuclear power plant

5	Understand the importance of power station estimation and economics.

UNIT-I	
Introduction	**08 Hours**
Steam Power plant: Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling systems.	
Generation of steam	**08Hours**
Steam Generators: Generation of steam using forced circulation, high and super critical pressures, a brief account of Benson and L'mont steam generators . **Chimneys**: Natural, forced, induced and balanced draft, Calculations involving height of Chimney to produce a given draft. **Cooling towers, Ponds and Accessories for the steam power plant**: Super heaters, De-super heater, Economizers, air pre heaters and re heaters	
UNIT-II	
	08 Hours
Solar and Wind Energy Power Plants: Solar Power Plant -Solar Thermal Collectors - Flat Plate and Concentrating Collectors, Solar chimney plant, low, medium and high temperature solar power plants, Solar desalination plant, solar pond plants, solar energy storage systems. Solar Photo Voltaics - Introduction, Fundamentals of photo Voltaic Conversion, Solar Cells, PV Systems, PV Applications. Wind energy power plants Introduction, HAWT and VAWT power plants, types, compare their relative merits and demerits and its Performance, Wind Energy Storage, Applications of Wind Energy, Safety and Environmental Aspects, site selection considerations and advantages and limitations of wind energy conversion. Hydro-Electric Plants: Storage and Pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, power house general layout, advantages and disadvantages over thermal power plant. Micro hydel plants	
	08 Hours
Gas turbine Power Plant: Advantages and disadvantages of gas turbine plant, open turbine plants with intercooling, reheating and regeneration. Closed gas turbine power plant. **Nuclear Power Plant** Principles of release of nuclear energy, fusion and fission reactions, nuclear fuels used in the reactors, Multiplication and thermal utilization factors, Elements of the nuclear reactor, moderator, control rod, fuel rods, coolants, Brief description of reactors of the following types Pressurized water reactor, boiling water reactor, sodium graphite reactor, fast breeder reactor and gas cooled reactor, radiation hazards, shielding, radioactive waste disposal.	
UNIT-III	
Power station estimation:	**08 Hours**
Power station estimation: Choice of site for power station, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, effect of variable load on power plant, selection of the number and size of units. **Economics of power generation:** Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy (Self-study topic).	

Course Outcomes: At the end of the course student will be able to

1.	Explain proximate and ultimate analysis of the coal. Illustrate the methods used for coal preparation, coal handling and burning (stoker and pulverised) of coal in steam power plants. Explain the methods used for ash handling in the power plant.
2.	Explain the method of steam generation in power plant using boilers. Differentiate the natural and forced draught and determine the height of the chimney to provide necessary draught. Describe the importance of cooling ponds, cooling towers and boiler accessories
3.	Determine the availability of water of a river and storage capacity required using the concept of hydrology. Describe the components and working of hydroelectric power plant and diesel engine power plant
4.	Describe the principle of nuclear energy release and differentiate nuclear fission and fusion reaction. Calculate energy released and fuel burn up during fission reactions. Explain the working of nuclear reactors and methods used for radioactive waste disposal. Explain open loop and closed loop gas turbine power plant and method used to improve the thermal efficiency.
5.	Discuss the social and environmental issues concerned with site selection. Explain the terminologies used in power plant economics. Calculate the energy produced using load and load duration curve. Calculate the cost of energy production and explain the tariff plans

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
ME2242-1.1	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**-**
ME2242-1.2	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**-**
ME2242-1.3	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**-**
ME2242-1.4	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**-**
ME2242-1.5	**2**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**1**	**-**	**2**	**-**	**2**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Power plant Engineering, P.K.Nag Tata McGraw Hill, 2 editions 2001
2.	Power plant Engineering by Domakundawar,Dhanpath Rai Sons.2003
3.	Power plant Engineering by R.K.Rajput. Laxmi Publication,New Delhi.
4	Principles of Energy conversion, AW.Culp Jr. McGraw Hill, 1996
5	Non-conventional Energy sources by G.D.Rai Khanna Publishers

REFERENCE BOOKS:

E Books / MOOCs/ NPTEL

1.	Power plant engineering by IIT Roorkee: https://youtu.be/tYBg-zsli98

Internal Combustion Engines

Course Code:	**ME2342-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1104-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Identify the thermal sciences related to IC engine; know combustion processes involved in S.I Engine and different variables affecting it.
2.	Demonstrate combustion process in C. I Engine and different variables affecting it also how methods of swirl generation lead to better combustion.

3.	Distinguish the various emissions from SI & CI engine and highlight the various control techniques used.
4.	Illustrate engine modification for the use of alternate fuels like LPG, Hydrogen & alcohol.
5.	Summarize the recent developments in engines and Measurement of different engine parameters.

UNIT-I	
SPARK IGNITION ENGINES: Spark ignition Engine mixture requirements - Feedback Control Carburettors -Fuel - Injection systems - Monopoint and Multipoint injection System- Stages of combustion - Normal and Abnormal Combustion-Factors affecting knock - Combustion Chambers -.	**08 Hours**
COMPRESSION IGNITION ENGINES: Stages of combustion in C.I. Engine - Direct and indirect injection systems -Combustion chambers Spray characteristics - Fuel spray behavior - spray structure, spray penetration and evaporation - Air motion – Turbocharging.	**10 Hours**
UNIT-II	
POLLUTANT FORMATION & CONTROL: Pollutant - Sources and types - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions – Mechanism of sooth and smoke formation. Pollutant Control - Methods of controlling Emissions- Catalytic converters and Particulate Traps-Methods of measurements and Driving cycles. Evolution and implementation of Bharath Stage norms.	**06 Hours**
ALTERNATIVE FUELS: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas, Bio-diesel. Properties, Suitability, Engine Modifications, Merits and Demerits as fuels.	**08 Hours**
UNIT-III	
RECENT TRENDS: Lean Burn Engines - Stratified Charge Engines - Gasoline Direct Injection Engine - Homogeneous Charge Compression Ignition, Fuel Cells - working, properties, merits and demerits. Introduction to Electric drives and Hybrids. Measurement techniques: Bosch Smoke meter, Hartridge smoke meter, Measurement of Brake Power by dynamometers. Future of IC Engines	**08 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Describe stages of the combustion processes involved in SI Engine and variables affecting it.
2.	Describe stages of the combustion processes involved in CI Engine and variables affecting it.
3.	Identify different types of emissions from SI & CI engines and explain techniques to solve air pollution problems.
4.	Explain the methods of production of alternative fuels for IC engines. Describe engine modification techniques used in IC engines for alternate fuels.
5.	Explain the recent trends in IC engines, SCI, HCCI, electric drives and fuel cells.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2342-1.1	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**
ME2342-1.2	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**

ME2342-1.3	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**
ME2342-1.4	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**
ME2342-1.5	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	John B. Heywood, "Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.
2.	Charles Fayette Taylor 'The Internal-combustion Engine in Theory and Practice, MIT PRESS Massachusetts Institute of Technology

REFERENCE BOOKS:

1.	Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2018.
2.	M.L Mathur and R.P.Sharma, " Internal Combustion Engine".
3.	Rowland S.Benson and N.D.Whitehouse, " Internal combustion Engines ", Vol.I and II, Pergamon Press, 1983.
4.	Duffy Smith, "Auto fuel Systems ", the Good Heart Willox Company, Inc., 1987.
5.	Ryan O Hayre, Suk – Woncha, Whitney colella, Fritz B.Prinz, "Fuel Cell Fundamentals", Second Edition, John Wiley Publication,2009.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1.	https://archive.nptel.ac.in/courses

TURBO MACHINES

Course Code:	**ME2343-1**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1005-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Able to give precise definition of turbo machinery
2.	Identify various types of turbo machinery
3.	Apply the Euler's equation for turbo machinery to analyse energy transfer in turbo machines
4.	Understand the principle of operation of pumps
5.	Perform the preliminary design of turbomachines (pumps, rotary compressors and turbines) and Analyze the performance of turbo machinery.

UNIT-I

Introduction: Definition of a Turbomachine, parts of turbomachines; Comparison with positive displacement machines; Classification: Application of first and second law's of thermodynamics to turbomachines, efficiencies, dimensionless parameters and their physical significance, effect of Reynolds number, Unit and specific quantities model studies, Efficiencies of turbo machines, Problems.	**07 Hours**
Thermodynamics of Fluid Flow: static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency, Stage efficiency (their comparison); polytropic efficiency for both Comparison and expansion process; Reheat factor for expansion process.	**08 Hours**

UNIT-II

Energy Transfer in Turbomachines: Euler's turbine equation, Alternate form of Euler's turbine equation, velocity triangles for different values of degree of reaction,	**07 Hours**

Components of energy transfer, Degree of Reaction, utilization factor , relation between utilization factor and degree of reaction, Problems. General Analysis of Turbomachines: **Radial flow compressors and pumps** - general analysis, expression for degree of reaction, velocity triangles, effect of blade discharge angle on energy transfer and degree of reaction, effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of Axial flow pumps and compressors , degree of reaction, velocity triangles, Problems.	
Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Compounding – Need & methods of compounding, Multistage impulse turbine – Expression for maximum utilization factor. Reaction turbine; Parson's reaction turbine, condition for maximum utilization factor, reaction staging, problems. Wind Turbines	**08 Hours**
UNIT-III	
Hydraulic Turbines: Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, maximum efficiency; Francis turbine - velocity triangles, design parameters runner shapes for different blade speeds; Draft tubes- Types & functions of draft tubes; Kaplan and Propeller turbines - velocity triangles, design parameters and problems. Draft tubes- Types & functions of draft tubes; Kaplan and Propeller turbines - velocity triangles, design parameters and problems.	**10 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain the construction, working and classification of Centrifugal pump.
2.	Explain suction, delivery and manometric heads, pressure rise in the impeller, and various efficiency terms like manometric efficiency, hydraulic efficiency, volumetric efficiency and overall efficiency.
3.	Explain multistage centrifugal pumps, minimum starting speed, slip, priming, cavitation N.P.S.H.
4.	Explain the construction and working of Centrifugal and an axial flow compressors.
5.	Analyze blade angles at impeller eye root and eye tip; slip factor and power input factor, width of the impeller channel.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2343-1.1	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**
ME2343-1.2	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**
ME2343-1.3	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**
ME2343-1.4	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**
ME2343-1.5	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	An Introduction to Energy Conversion, Volume III, Turbomachinery, V. Kadambi and
2.	Manohar Prasad, New Age International Publishers (P), Ltd.

REFERENCE BOOKS:

1.	Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company (1964).
2.	R2.Fluid Mechanics & Thermodynamics of Turbomachines S.L.Dixon, Elsevier (2005).
3.	R3.A Text book of Turbomachines – M. S. Govindegowda and A. M. Nagaraj – M. M.

Program Specific Ability Enhancement Courses

Data Acquisition and Measurements

Course Code	**ME1651-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To be able to identity a data acquisition system.
2.	To be able to prescribe a sensor type to measure a specific environmental change.
3.	To be able to determine what type of amplifier is needed for a specific sensor output.
4.	To be familiar with different forms of signal conditioning.

List of Modules

1	Data Acquisition Overview Sensor Types Overview, Application Areas and Trends, LabVIEW Introduction.
2	Data Acquisition System Features System Components, Signal Characteristics, Signal Conditioning, Signal Source and Measurement System Configuration
3	Analog to Digital Conversion elements Key analog to digital conversion parameters, Measurement Error, Triggers LabVIEW – Sub Vis Filters (signal conditioning), Amplification (signal conditioning).
4	Analog to Digital Conversion characteristics part A Voltage resolution, Quantization error, Lab assignmentsAnalog to Digital Conversion characteristics part B Main characteristics, Methods of representation, Analog to Digital converter

Course Outcomes: At the end of the course student will be able to

1.	Identity a data acquisition system and to prescribe a sensor type to measure a specific environmental change.
2.	Determine what type of amplifier is needed for a specific sensor output.
3.	Make use signal conditioning and analog-to-digital conversion in LabVIEW.
4.	Identify the type of interface used to get a digital signal into a microprocessor.
5.	Use of software package to view data on a PC and be familiar with different forms of data transmission.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1651-1.1	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**3**	**1**	**-**	**2**	**3**	**1**	**2**
ME1651-1.2	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**3**	**1**	**2**
ME1651-1.3	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**	**3**	**1**	**2**
ME1651-1.4	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**2**	**3**	**1**	**2**
ME1651-1.5	**3**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**3**	**2**	**2**	**3**	**3**	**1**	**2**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	1. LabView Student Edition, 1st. Edition by Robert H. Bishop ISBN-13: 978-0134011332

E Resources

1.	Introduction to Data Acquisition with LabView 2nd. Edition by Robert King, ISBN-13: 9780073385877

Data Processing and Plotting

Course Code	**ME1652-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Explain fundamentals of data processing using python
2.	Understand the Matrices Operation and implement using python libraries
3.	Introduction to regression and correlation
4.	Understand the significance of Interpolation and extrapolation Different types of plots and use of Matplotlib library

List of Modules

1	Predictive Analytics: Hypothesis Testing & Business Analytics Hypothesis Testing: Null and Alternative Hypotheses; Z Test, t test and F test,
2	Python Modules & Packages for Data Science/ Analytics: Pandas, Matplotlib, NumPy toolboxes of Python to help solve Predictive and Prescriptive analytics problems. Reading and writing fileData Mining and Clustering: Normalization of data, Regression and correlation, ANOVA, and Clustering techniques Problems solving using python modules
3	Matrices Manipulation: Matrix Addition, Multiplication, Interpolation, and extrapolation
4	Problems solving using NumPy libraries Introduction to Pandas and Scipy
5	Types of Plots: Scatter Plots, Subplots Histograms, Pie-chart, Bar Chart Introduction to Matplotlib

Course Outcomes: At the end of the course student will be able to

1.	Apply the knowledge of data processing using python.
2.	Understand the Matrices Operation and implement using python libraries.
3.	Apply regression and correlation using python.
4.	Understand Interpolation and extrapolation techniques.
5.	Knowledge of different types of plots and use of Matplotlib library

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1652-1.1	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**
ME1652-1.2	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**
ME1652-1.3	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**
ME1652-1.4	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**
ME1652-1.5	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	“Python for Data Science for Dummies”, Luca Massaron and John Paul Mueller, Wiley,2015
2.	“Pandas in Action”, Boris Paskhaver, Manning publication,2021
3.	“Python for Data Analysis”, Wes McKinney, O’REILLY,2017

E Resources

1.	Introduction to Data Science in Python https://www.coursera.org/learn/python-data-analysis

Fundamentals of Mechatronics system

Course Code	**ME1653-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	1. Analyse, design and develop the hydraulics and pneumatics circuits for industrial applications.
2.	2. Analyse, design and develop the Electro pneumatic, electrohydraulic and PLC based control systems for automation task

List of Modules

1	**Hydraulics and Pneumatics:** Basic components of Hydraulic and Pneumatic system, Control valves and actuators in pneumatics and hydraulics Experiments: Pneumatics Allocating device Separating parcel post. Quarry stone sorter Compactor for domestic rubbish Experiments: Hydraulics Hydraulic press with hand lever Pressure regulator for stamping application. Hydraulic Cylinders With Flow Control Valves
2	**Programmable logic controller:** Relay, NO and NC switch, Electrical circuits diagram. Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching & selection of a PLC. **Experiments: Electro PneumaticsDiverting device** 1. Clamping device **Experiments: Electro Hydraulics** 1. Sorting device 2. Bending device **Experiments: Programmable logic controller (Pneumatics)** 1. Stamping device 2. Combination of AND/OR/NOT 3. Drill breakage monitoring 4. Setting and resetting an output Experiments: **Programmable logic controller**(Hydraulics)Advance stroke speed control.Stamping operation.

Course Outcomes: At the end of the course student will be able to

1.	Design and develop Hydraulics and pneumatics circuits for industrial applications.
2.	Design and develop Electro pneumatic, electrohydraulic and PLC based control systems for automation tasks.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**

↓ Course Outcomes													1	2	3
ME1653-1.1	**2**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**1**	**-**	**3**
ME1653-1.2	**2**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**2**	**-**	**3**
1: Low 2: Medium 3: High															

REFERENCE MATERIALS:

1.	"Mechatronics'', W. Bolton, Pearson education, third edition. 2013
2.	"Hydraulics and Pneumatics" . R Srinivasan, Tata McGraw-Hill, Publishing company,ltd. 2008

E Resources

1.	https://www.festo.com/us/en/e/technical-education/digital-learning/elearning-id_31269/

Innovation and Design Thinking

Course Code	**ME1654-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To explain the concept of design thinking for product and service development
2.	To explain the fundamental concept of innovation and design thinking
3.	To discuss the methods of implementing design thinking in the real world.
	Note: Teaching-Learning Process (General Instructions) These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes. 1. Lecturer method (L) does not mean only the traditional lecture method, but a ifferent type of teaching method may be adopted to develop the outcomes. 2. Show Video/animation films to explain concepts 3. Encourage collaborative (Group Learning) Learning in the class 4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking 5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it. 6. Topics will be introduced in multiple representations. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

List of Modules

1.	**PROCESS OF DESIGN** Understanding Design thinking Shared model in team-based design – Theory and practice in Design thinking – Explore the presentation Tools for Design Thinking Real-Time design interaction capture and analysis – Empathy for design

	Teaching-Learning Process Introduction about the design thinking: Chalk and Talk method Theory and practice through presentation Case studies on design thinking for real-time interaction and analysis
2.	**Design Thinking in IT** Design Thinking to Business Process modeling – Scenario-based Prototyping DT For strategic innovations Growth – Storytelling representation – Strategic Foresight - Change – Sense Making – Maintenance - Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design. Teaching-Learning Process Case studies on design thinking and business acceptance of the design Business model examples of successful designs
3.	Design thinking workshop Design Thinking Workshop Empathize, Design, Ideate, Prototype and Test Teaching-Learning Process Presentation by the students on the success of Live project on design thinking in a group of 4 students

Course Outcomes: Upon the successful completion of the course, students will be able to:

1.	Appreciate various design process procedure
2.	Generate and develop design ideas through a different techniques
3.	Identify the significance of Design Thinking to Understand products

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1654-1.1	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
ME1654-1.2	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
ME1654-1.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1**	**1**	**1**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2.	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",Harvard Business Press , 2009.
3.	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply", Springer, 2011
4.	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
5.	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, SecondEdition, 2011.
6.	Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia BusinessSchool Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author),Kevin Bennett (Author).

E Resources

1.	www.tutor2u.net/business/presentations/. /productlifecycle/default.html
2.	https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
3.	www.bizfilings.com › Home › Marketing › Product Developmen
4.	https://www.mindtools.com/brainstm.html
5.	https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
6.	www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
7.	https://support.google.com/docs/answer/179740?hl=en

8.	https://www.youtube.com/watch?v=2mjSDIBaUlM thevirtualinstructor.com/foreshortening.html https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf https://dschool.stanford.edu/use-our-methods/ 6. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process 7. http://www.creativityatwork.com/design-thinking-strategy-for-innovation/ 49 8. https://www.nngroup.com/articles/design-thinking/ 9. https://designthinkingforeducators.com/design-thinking/ 10. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf
9.	Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • http://dschool.stanford.edu/dgift/

Introduction to AI and ML

Course Code	**ME1655-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Course objectives: To understand the fundamentals of AI and ML and its applications

List of Experiments

1.	Introduction to AI, Applications, basics of AI, ANN basics – perceptron, MLP, FFNN, Back-Propagation.
2.	Introduction to ML, ML techniques overview, significance of feature extraction and dimensionality reduction, clustering, Artificial neural networks, Support vector machines
3.	Introduction to Deep learning, difference between ML and DL, Convolutional neural networks, Recurrent neural networks, applications

Course Outcomes: At the end of the course student will be able to

1.	Explain about AI, its basics, significance and its applications
2.	Describe about ML, different techniques, about the significance of feature extraction and dimensionality reduction and about artificial neural networks and support vector machines.
3	Differentiate between ML and DL, explain convolutional and recurrent neural networks and its applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1655-1.1	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**1**	**1**	**1**
ME1655-1.2	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**1**	**1**	**1**
ME1655-1.3	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**1**	**1**	**1**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Stuart J.Russel & Peter Norvig, Artificial Intelligence – A Modern Approach, Third Edition, Pearson Education India, ISBN-13 : 978-9332543515.
2.	Ethem Alpaydin, Introduction to Machine learning, The MIT Press Reader, 2014, ISBN: 9780262028189

Principles of Welding

Course Code	**ME1658-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To demonstrate the physics of welding arc in conventional arc welding processes. To demonstrate the characteristics of conventional of electronic power sources for welding

List of Experiments

1.	Classification of welding processes, Conventional Arc welding processes, Physics of welding arc- General characteristics of an arc, ionisation, dissociation, arc column, anode and cathode fall zones. Electrical conductivity of the arc, heat transfer inside the arc and arc ignition.
2.	Electrical power sources for welding - General characteristics, conventional and electronic power regulator systems –Tapped transformers, Moving-iron control, Variable inductor, Magnetic amplifier, SCR phase control, Transistor series regulator, Secondary switched transistor power supplies, Primary rectifier-inverter, hybrid designs and microprocessor-controlled power sources.

Course Outcomes: At the end of the course student will be able to

1.	Describe the physics of the welding arc. Also, will be able to differentiate between a conventional and electronic power sources.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1658-1.1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Advanced welding processes by John Norrish, ISBN: 978-1-84569-130-1.
2.	Principles of Welding by Robert W. Messler Jr., ISBN: 978-0-471-25376-1
3.	Welding Technology by G. den Ouden and M. Hermans, ISBN: 978-90-6562-205-1.
4.	The Physics of Welding, J.F. Lancaster, ISBN: 0-08-034076

Startup Policy and General Compliances

Course Code	**ME1660-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
2.	Demonstrate an ability to design a business model canvas.
3.	Evaluate the various sources of raising finance for startup ventures.
4.	Understand the fundamentals of developing business pitching to potential investors
5.	Understand the fundamentals of presenting business pitching to potential investors

Modules

1.	**Entrepreneurial Process and Decision Making:** Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation **Fundamentals of choosing the Business Organization form for startup:** Why we need a business form for startup? How to choose appropriate business form for startup? Comparative analysis of Incorporation requirement. Comparative Analysis of compliance cost, Other formalities to comply.
2.	**Crafting business models and Lean Start-ups**: Introduction to business models; Creating value propositions- conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching. **Organizing Business and Entrepreneurial Finance**: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship. Laws relating to incorporation of Partnership, LL.P & Co – operative, Laws relating to incorporation of One Person Company, Pvt. Ltd., Pub. Ltd. And not for profit company

Course Outcomes: At the end of the course student will be able to

1.	Explain the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
2.	Demonstrate an ability to design a business model canvas.
3.	Evaluate the various sources of raising finance for startup ventures.
4.	Explain the fundamentals of developing business pitching to potential investors.
5.	Explain the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1660-1.1	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**
ME1660-1.2	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**
ME1660-1.3	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**
ME1660-1.4	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
ME1660-1.5	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.
2.	Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch. S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)

E Resources

1.	1. C R Dutta on Company Law, 8th ed. 2008, Lexis Nexis New Delhi.
2.	2. Pollock & Mulla's Indian PartnershipAct, 7th ed. 2011, Lexis Nexis New Delhi.

Technical Report writing and Presentation

Course Code	**ME1661-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Knowledge of the basics of technical writing and its guidelines.
2.	Understanding to prepare formal and informal reports.
3.	To apply effective reading, writing and communication skills in writing memos, proposals, covering letter, brochures, newsletter, job application letter, business letters, feasibility reports, manual writing.
4.	To recognize the importance of ethical communication.
5	To write the technical report in a proper sequence and present the project in power point presentation

List of Modules

1.	Introduction to the Technical Report:Writing the title of the Report, Abstract ,Acknowledgement, Table of Content
2.	List of Figures, List of Abbreviations used Literature surveyIntroduction to the topic and experiments
3.	Presentation of findings: Results and Discussion: Plotting results in graphs and Sketches
4.	Conclusions and References, Plagiarism check
5.	Preparation of Technical presentation using Power Point

Course Outcomes: At the end of the course student will be able to

1.	Explain the basics of technical writing and its guidelines
2.	Prepare formal and informal reports
3.	Apply effective reading, writing and communication skills in writing memos, proposals, covering letter, brochures, newsletter, job application letter, business letters, feasibility reports, manual writing.
4.	Recognize the importance of ethical communication and Plagiarism
5.	To write the technical report in a proper sequence and present the project in power point presentation

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1661-1.1	**1**	-	-	-	**1**	-	-	-	-	**3**	-	-	-	-	-
ME1661-1.2	**1**	-	-	-	**1**	-	-	-	-	**3**	-	-	-	-	-
ME1661-1.3	**1**	-	-	-	**1**	-	-	-	-	**3**	-	-	-	-	-
ME1661-1.4	**1**	-	-	-	**1**	-	-	**4**	-	**3**	-	-	-	-	-
ME1661-1.5	**1**	-	-	-	**1**	-	-	-	-	**3**	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1. "How To Write and Publish a Scientific Paper", Robert A. Day, Fifth Edition, Oryx Press, Phoenix, AZ, 1998.
2. Technical Report Writing Today by Daniel G. Riordan and Steven E. Pauley, Cengage advantage 10^{th} edition

E Resources

AUTOMOTIVE ELECTRONICS

Course Code	**ME2651-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the overall electrical and electronic architecture of the vehicle and perform basic electronics experiments.
2.	Understand the working of sensors and actuators used in Automotive Applications

List of Experiments

	Identification of Various Electronic Devices: Resistor, Capacitor, Inductor, Diode, Digitial Multi Meter, DC regulated Power Supply, Study of Digital CRO, Function Generator, Bread board, Soldering
	Electrical and Electronic Systems: Electrical Architecture of the vehicle – Two and Four Wheelers, Introduction to Basic Microcontroller
	Conduct experiment on Half wave rectifier and full wave rectifier with and without filter and measure the ripple factor.
	Design a Zener voltage regulator to determine the line and load regulations
	Design of regulated power supply
	Conduct an experiment to find the characteristics of LDR and Photo diode and to turn on an LED using LDR.
	Conduct the experiment to find the characteristics of solar cell
	Testing of Batteries and its Maintenance
	Testing of starter motor and alternator
	Automotive Electrical Wiring
	Different types of Automotive Sensor circuits – MAP Sensor, Throttle Position Sensor, Accelerator Pedal Sensor, Engine Coolant Temperature Sensor, Intake Air Temperature Sensor
	Circuit Simulation through LTSpice and KiCAD

Course Outcomes: At the end of the course student will be able to

1.	Design and develop the basic electronic circuits required for various applications
2.	Design and develop electrical and electronic systems used in an automobile

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2651-1.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**3**	**2**	**-**
ME2651-1.2	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**1**	**3**	**2**	**-**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Bosch, Robert, ed. Bosch automotive electrics and automotive electronics: systems and components, networking and hybrid drive. Springer Vieweg., 2014.
2.	Ribbens, William. Understanding automotive electronics: an engineering perspective. Butterworth-heinemann, 2017.
3.	Denton, Tom. Automobile electrical and electronic systems. Routledge, 2017.

E Resources

1.	Automotive Electronics, https://www.youtube.com/watch?v=tyP97QbrsEI&list=PLAMZfGOiiA2NYHfC2tUIJVRLWf6dTEP0I

Business Analytics with Python I – Predictive Analytics

Course Code	**ME2652-1**	**Course Type**	**AEC**

Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1657-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Apply the concepts of predictive analytics and solve problems related to hypothesis testing, control charts, regression and correlation and time series analysis.
2.	Apply relevant python toolboxes/ modules to programs for problems related to predictive analytics.

List of Experiments

1.	Introduction to Business Analytics Types of data, representation of data using Measures of central tendency and dispersion, Central Limit theorem. Predictive Analytics Hypothesis Testing & Business Analytics Hypothesis Testing: Null and Alternative Hypotheses; Z Test, t test and F test. Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems. Process capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk. – Process capability ratio, Concept of Six sigma Correlation: Linear (Simple and Multiple) correlation and linear regression. Time Series Analysis: Components of time series, Trend analysis: Least Square method of Forecasting, Numerical Problems.
2.	Python Modules & Packages for Data Science/ Analytics: Pandas, Matplotlib, NumPy, Dataframe, and other toolboxes of Python to help solve Predictive analytics problems. Python application in prescriptive Analytics: Application of Python modules to solve at least one problem of Data retrieval from spreadsheets, Z test, t test and F tests, Time Series analysis, Correlation, and regression, plotting control charts and finding process capability.

Course Outcomes: At the end of the course student will be able to

1.	Apply concepts of predictive analytics and solve problems related to hypothesis testing, control charts, regression and correlation and time series analysis.
2.	Apply relevant python modules/ toolboxes to write programs to solve predictive analytics problems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2652-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**3**
ME2652-1.2	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8thEdition. 2011
2.	Total Quality Management, Dale H. Besterfield et al., Pearson Education, 3rd edition, 2011

E Resources

1.	NPTEL course material related to business analytics

2.	openbookproject.net/thinkcs/python/english2e

CNC PROGRAMMING AND MACHINING

Course Code	**ME2653-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME2003-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the programming part using ISO codes , analyze and to write manual part programming for simple machine parts of CNC turning and machining.
2.	Learn to write the manual part programming of simple components for CNC milling and machining.

List of Experiments

1.	Writing manual part programming using ISO codes for machining of simple machine parts in CNC turning machine and machining the model.
2.	Simple Turning
3.	Step Facing
4.	Taper Turning
5.	Multiple Turning
6.	Drilling and Boring
7.	Writing manual part programming using ISO codes for machining of simple machine parts in CNC milling machine.
8.	Slotting
9.	Pocketing
10.	Mirroring
11.	Cutter Radius Compensation
12.	Drilling

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate the simulation of the tool path for the given part by using Numerical Control (NC) codes for CNC turning. Demonstrate the use of machining cycles and subprograms for repetitive tool path applications in turning.
2.	Demonstrate the simulation of the tool path for the given part by using Numerical Control (NC) codes for CNC milling. Demonstrate the use of machining cycles and subprograms for repetitive tool path applications in milling.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2653-1.1	**1**	**2**	**1**	**-**	**3**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**3**
ME2653-1.2	**2**	**2**	**1**	**-**	**3**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	“Computer aided design and manufacturing” Groover Mikell P. and Zimmers Emory W Prentice Hall of India , New Delhi .(2003).
2.	“’Manufacturing Automation Metal Cutting Mechanics, Machine Tool Vibrations, CNC Design”, Yusuf, Cambridge University Press

Introduction to Design and Fabrication of Unmanned Aerial Vehicles

Course Code	**ME2654-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1301-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Explain the types of UAV, principles of fight, misiion profile, Kinematics and dynamics of Fixed wing UAV and Quadcopters.
2.	Explain the functions of various electronic components, guidance, navigation and control of UAV. Build/ Demonstrate the function of various elements of Fixed wing Aircrafts and Quadcopters

List of Experiments

1.	Introduction, Definition and terminology, Classification of UAV, Military and Civilian Unmanned UAV, Principles of flight, UAV fundamentals, Kinematics and Dynamics of Fixed wing UAV and Quadcopters, Mission profile of UAVs.
2.	Electronic components of Radio-controlled Aircrafts and Quadcopters, Principles of Gudance, Navigation and control of UAVs, UAV mission and path planning. Sizing and design calculations, Lab exercises on building and assembling RC Planes and Quadcopters. Practice sessions on flying simulation software

Course Outcomes: At the end of the course student will be able to

1.	Explain the types of UAV, principles of fight, misiion profile, Kinematics and dynamics of Fixed wing UAV and Quadcopters.
2.	Explain the functions of various electronic components, guidance, navigation and control of UAV. Build/ Demonstrate the function of various elements of Fixed wing Aircrafts and Quadcopters

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2654-1.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**3**
ME2654-1.2	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**3**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Handbook of UAVs, Kimon P. Valavanis, George J Vachtsevanos, Springer Reference, 2015
2.	Flight without Formulae by A.C Kermode, Pearson Education,10th Edition
3.	Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition
4.	Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition

E Resources-

1.	NPTEL videos and materials on Aircraft/ UAV design.

Non-Destructive Inspection

Course Code	**ME2655-1**	**Course Type**	**AEC**

Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To summarize the various types of discontinuities and select the possible NDT methods which may be employed to detect each type of discontinuity.

List of Experiments

1.	Defects in Materials- casting defects, forging and rolling defects, extrusion defects, drawing defects, welding defects, grinding cracks, defects introduced during service.
2.	Selection of NDT methods & Instrumentation: Visual testing, liquid penetrant testing, Magnetic particle testing, Eddy current testing, Radiographic testing, Ultrasound testing, Acoustic emission testing, Thermography

Course Outcomes: At the end of the course student will be able to

1.	Suggest a suitable NDT technique to be employed to detect a particular discontinuity in a material.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2655-1.1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**3**

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Practical Non-destructuve Testing Baldev Raj, C. V. Subramanian, and T. Jayakumar, ISBN:978-81-7319-797-0
2.	Nondestructive Testing, Louis Cartz, ASM International
	Nondestructive Evaluation and Quality Control, ASM Handbook, Vol. 17

Welding Automation

Course Code	**ME2656-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+50**
Prerequisite	**ME1006-1**		

Teaching Department: Mechanical Engineering

Course Objectives:

1.	1. To develop awareness of the advantages / disadvantages of automation. To develop an awareness of available equipment/components used in welding automation.

List of Experiments

1.	Discuss the application of automation to the welding process. Types of welding automation – machine welding, Robotic welding, arc welding robots.
2.	Welding automation parts, drives, control system – welding gun, tractors, carriages, seam tracking, Number of axis, mechanical parts, motors, controllers, sensors, interfacing

Course Outcomes: At the end of the course student will be able to

1.	Describe the necessity of automation in welding and List the components required for welding automation.

Course Outcomes Mapping with Program Outcomes & PSO															
Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME2656-1.1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**3**
1: Low 2: Medium 3: High															

REFERENCE MATERIALS:

1.	Automating the Welding Process: Successful Implementation of Automated Welding Systems, James M. Berge, 1995
2.	Automation and Robotisation in Welding and Allied Processes, P. D. Boyd, 2013

Humanities & Management Courses

ENHANCING SELF-COMPETENCE

Course Code:	**HU2001-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**26+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Introspect and learn about oneself.
2.	Develop professional writing skills.
3.	Acquaint with the various social behaviour and etiquette.
4.	Apply the techniques of fundamental communication skills.
5.	Develop necessary techniques for formal presentations.

UNIT-I

Personality Traits — **09 Hours**

Types & Kinds of personality, Ways to Identify Self (SWOT Analysis, Johari Window), Concepts of Self-Management and Self-Motivation

Effective Communication Skills

One-way and Two-way Communication, Interpersonal & Social Skills

UNIT-II

Social Behaviour and Cultural Etiquette — **09 Hours**

Time Management, Personal Grooming, Making Small Talk, Customs & Manners

Professional Presentation Techniques

Formal Presentation, Sensitivity towards multi-cultural workspaces

UNIT-III

Job-Related Communication — **08 Hours**

Resume & Cover Letter, Formal E-mails, Framing Requests, Greetings, Salutations, Close

Course Outcomes: At the end of the course student will be able to

1.	Understand the importance of human conduct.
2.	Demonstrate knowledge of theory and competence in office communication.
3.	Develop and assess various types of communication.
4.	Be Familiar with the current practices of social behaviour.
5.	Prepare and deliver presentation appropriate for the workplace.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
HU2001-1.1	-	1	-	-	-	2	2	-	3	-	-	-	-	-	-
HU2001-1.2	-	-	-	-	-	-	-	3	2	1	-	1	-	-	-
HU2001-1.3	-	-	2	-	-	2	2	2	-	-	-	2	-	-	-
HU2001-1.4	-	3	-	-	-	-	-	-	2	3	2	-	-	-	-
HU2001-1.5	2	2	-	1	-	-	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics”, Excel Books, New Delhi, 2010.
2. Ronald B Adler and Jeanne Marquardt Elmhorst, "Communicating at Work – Principles and Practices for Business and the Professions", 6th Edition, McGraw Hill College.
3. Stephen R. Covey, "The 7 Habits of Highly Effective People", Simon & Schuster, 1994.

4.	Sarvesh Gulati, "Corporate grooming and Etiquette", Rupa Publications India Pvt. Ltd., 2010.
5.	Fred. Luthans, "Organizational Behaviour", McGraw Hill International.
6.	Tom Rath, “Strengths Finder 2.0", Gallup Press, 2007.
7.	M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw- Hill, 2005.
8.	Stephen P. Robbins, "Organizational Behaviour", Prentice Hall.
9.	Dale Carnegie, "How to Win Friends and Influence People", Gallery Books, 2016.

UNIVERSAL HUMAN VALUES

Course Code:	**HU1004-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Enable students appreciate values, skills and behaviour with an appropriate understanding of ‘Self’ to attain sustained happiness and prosperity with right aspirations of life.
2.	Develop a holistic perspective among the students towards physical needs and prosperity of life.
3.	Develop a holistic approach and understand the importance of co-existence and living in harmony ensuring mutually fulfilling interaction with the society and nature.
4.	Strengthening of self-reflection.
5.	Development of commitment and courage to act.

UNIT-I

Need, Basic Guidelines, Content and Process for Value Education	**06 Hours**

Self-Exploration; ‘Natural Acceptance’ and Experiential Validation; Continuous Happiness and Prosperity; Right understanding, Relationship and Physical Facility; Understanding Happiness and Prosperity - living in harmony at various levels.

UNIT-II

Understanding Harmony in the Human Being, Family and Society	**06 Hours**

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body; the needs of Self (‘I’) and ‘Body’; the Body as an instrument; Holistic perspective of Physical needs and Prosperity; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

UNIT-III

Whole existence as Coexistence: Implications of the above Holistic Understanding of Harmony and Professional Ethics	**03 Hours**

Understanding the harmony in the Nature and Existence; Existence as Co-existence, Holistic perception of harmony at all levels of existence; Natural acceptance of human values, Professional Ethics

Course Outcomes: At the end of the course student will be able to

1.	Have a better self-exploration and understanding with a capacity to identify the priorities of life.
2.	Generate Sustainable solution to problems with focus on human values and value-based living.
3.	Have an understanding of the Holistic perspective of Physical needs
4.	Understand and practice living in harmony, co-existence and natural acceptance

5.	Exhibit Professional Ethics in the workplace

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
HU1004-1.1	-	-	-	-	-	-	-	3	-	-	2	2	-	-	-
HU1004-1.2	-	-	-	-	-	-	-	2	-	-	2	2	-	-	-
HU1004-1.3	-	-	2	-	-	-	1	2	-	-	2	2	-	-	-
HU1004-1.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
HU1004-1.5	-	-	1	-	-	-	-	3	-	-	2	2	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. A Nagaraj, "Jeevan Vidya: Ek Parichaya", Jeevan Vidya Prakashan, Amarkantak, 1999
2. A.N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth"
5. E. F Schumacher, "Small is Beautiful"
6. Cecile Andrews, "Slow is Beautiful"
7. J C Kumarappa, "Economy of Permanence"
8. Pandit Sunderlal, "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas Karamchand Gandhi, "Indian Home Rule"
11. Maulana Abdul Kalam Azad, "India Wins Freedom"
12. Romain Rolland, "Vivekananda"
13. Romain Rolland, "Gandhi"

ESSENCE OF INDIAN CULTURE

Course Code:	**HU1005-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	To facilitate students with the concepts of Indian Culture and to make them understand the roots of knowledge system.
2.	To acquaint students with Indian Culture and inculcate an ability to analyze it.
3.	To apply various approaches for the enhancement of living ideals based on Indian traditional knowledge.

UNIT-I

Introduction to Traditional Knowledge	**6 Hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge and its characteristics, Traditional Knowledge vis-a-vis Indigenous Knowledge, Traditional Knowledge vis-a-vis Western Knowledge

UNIT-II

Significance of Traditional Knowledge	**6 Hours**

Value of Traditional Knowledge in global economy, Role of Government in harnessing Traditional Knowledge, Traditional medicine system, Traditional Knowledge in agriculture. food and healthcare.

UNIT-III

Holistic Healthcare for Human Well-being	**3 Hours**

Definition of Ayurveda, Ayurveda for Life, Health and Well-being, Introduction to principles of Ayurvedic healing and Astanga Ayurveda.

Course Outcomes: At the end of the course student will be able to

1.	Identify the concept of Traditional Knowledge and its importance.
2.	Explain the need for and importance of protecting Traditional Knowledge.
3.	Illustrate the various enactments related to Traditional Knowledge.
4.	Familiarize the importance of Holistic Healthcare.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1005-1.1	-	-	-	-	-	-	-	-	-	2	2	3	-	-
HU1005-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1005-1.3	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1005-1.4	-	-	-	-	-	-	-	-	2	2	2	2	-	-
HU1005-1.5	-	-	-	-	-	-	-	-	1	2	2	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1. Jha, A., "Traditional Knowledge System in India", Atlantic Publishers, 2002.
2. Kapoor, K., & Danino, M., "Knowledge Traditions and Practices of India", 2012.
3. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", Medknow Publications and Media.
4. Jha, R.N., "Science of Consciousness Psychotherapy and Yoga Practices", Delhi: Vidyanidhi Prakashan, 2015.
5. TEDx Talks. (2015, February 6). Unleashing the Power of Traditional Medicine | Dr. Arvind Singh [Video file]. Retrieved from https://www.youtube.com/watch?v=LZP1StpYEPM

INTRODUCTION TO IPR

Course Code:	**HU1006-1**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Enhancing the learning system through innovation and creative thinking skills for effective business process.
2.	Acquaint with special challenges of starting new ventures.
3.	Facilitate Entrepreneurial skills in recognizing opportunities for competitive advantages.
4.	Provide insights of financial aspects in planning and executing a business plan.
5.	Ascertain the role of IPR to protect innovations and intangible assets.

UNIT-I

Intellectual Property Rights (IPR)	**6 Hours**

Introduction to IPR: Business Perspective, IPR in India – Genesis and Development, International Context, Concept of IP Management, Uses in marketing

UNIT-II

Types of Intellectual Property	**6 Hours**

Patent - Procedure, Licensing and Assignment, Infringement and Penalty, Trademark, Example of Trademarks - Domain name, Geographical Indications, Copyright, Industrial Designs, Class Discussion - Major Court Cases regarding violation of Patents

UNIT-III

Basic Tenets of Information Technology Act, 2000	**3 Hours**

IT Act – Introduction, E-Commerce and Legal Provisions, E- Governance, Digital signature and Electronic Signature, Cybercrimes

Course Outcomes: At the end of the course student will be able to

1.	Comprehend Innovation, its process and sources.
2.	Apply the process of building an innovative organization.
3.	Recognize the characteristics of different types of Entrepreneurships
4.	Formulate a business plan based on a business idea in Technology.
5.	Interpret basic tenets of Information Technology Act, 2000.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1006-1.1	-	-	-	-	-	-	-	-	-	2	-	3	-	-
HU1006-1.2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
HU1006-1.3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
HU1006-1.4	-	-	-	-	-	-	-	-	2	2	-	2	-	-
HU1006-1.5	-	-	-	-	-	-	-	-	1	2	-	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1.	Tidd, J., & Bessant, J., "Managing Innovation: Integrating Technological, Market and Organizational Change", Wiley, 2021.
2.	Case Study Materials: To be distributed for Class Discussion
3.	Reddy, G. B., "Intellectual Property Rights and the Law", Gogia Law Agency, 2012.
4.	Wadehra, B. L., "Law relating to Intellectual Property", Universal Law Publishing Co., 2011.
5.	Narayanan, P., "IPR", Eastern Law House Private Ltd, 2017.

SOCIAL CONNECT AND RESPONSIBILITY

Course Code:	**HU1007-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Understand Rural Society
2.	Acquire the knowledge about Rural Economy
3.	Know the working of rural administration
4.	Familiarize the different rural schemes of Governance

UNIT-I	
Appreciation of Rural Society	**3 Hours**
Rural Society, Caste and Gender relations, Rural values, Nature and Resources, Rural infrastructure.	
Understanding Rural Economy & Livelihood	**3 Hours**
Agriculture, Farming, Landownership, Water Management, Animal Husbandry, Non-Farm Livelihoods And Artisans, Rural Entrepreneurs.	
UNIT-II	
Rural Institutions	**3 Hours**
Traditional Rural Organizations, Self-help Groups, Panchayat Raj Institutions - Gram Sabha, Gram Panchayat, Standing Committees	
Rural Development Programmes	**3 Hours**
History of Rural Development in India, Current National Programmes - Sarva Shiksha Abhiyaan, Beti Bachao – Beti Padhao, Ayushmaan Bharath, Swachh Bharath, PM Awaas Yojana, Skill India, Decentralised Planning, NRLM, MNREGA	
UNIT-III	
Corporate Social Responsibility (CSR)	**3 Hours**
Global Guidelines on CSR, Growing Importance of CSR, CSR in India	

Course Outcomes: At the end of the course student will be able to

1.	Comprehend Rural Society and its Economy
2.	Identify the working of Rural Administration and different rural schemes
3.	Grasp the working of Corporate Social Responsibility

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1007-1.1	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1007-1.2	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1007-1.3	-	-	-	-	-	-	-	-	-	-	2	3	-	-

1: Low 2: Medium 3: High

REFERENCES:

1.	UGC., “Unnat Bharat Abhiyan”, 2020
2.	Agarwal, S.K., “Corporate Social Responsibility in India”, SAGE Publication, 2008.
3.	Unnat Bharat Abhiyan. (n.d.). Unnat Bharat Abhiyan Brochure. Retrieved from https://unnatbharatabhiyan.gov.in/app/webroot/files/brochure.pdf

LIFE SKILLS FOR ENGINEERS

Course Code:	**HU1008-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Understand Time Management, Managing Information Overload, Coping with Peer pressure and Stress Management
2.	Familiarize the Science behind Personal Health Management and Addictions

3.	Appreciate the importance of cultivating good hobbies, need for forming good habits and discarding bad habits and holding difficult conversations during crises
4.	Comprehend the importance of Creative Thinking, Continuous and Lifelong Learning, Collaboration and Team Work
5.	Equip them to excel in real work environment proactively

UNIT-I

Introduction to Life Skills	**3 Hours**

Meaning and Importance of Life Skills, Competitive Job market, Fast paced changes in Technology, Proliferation of Electronic Gadgets and harmful online content.

Time Management

Introduction to Time Management, Impulsive Behaviour vis-a-vis goal Directive Behaviour, Time log, Information Overload and coping with Information & Communication Technology (ICT) Revolution; Proliferation of Electronic Media; Exponential growth in online content; Impact of Information Overload on human brain

Science behind Personal Health Management	**3 Hours**

Ignorance in Society on health issues, World Health Organization (WHO) - Definition of Health, Human Evolution, Importance of physical work for human body & mind, Dangers of sedentary lifestyle, Germ diseases versus Lifestyle diseases, Integrating physical exercise into daily life

Science behind Addictions

Addiction - Meaning, Neurology and Hormonal basics of Addictive Behaviour, How addictions are formed; Harmful effects of addictions on Physical and Mental Health, Recognizing addictions in oneself, Coming out of addictions

UNIT-II

Need for cultivating good hobbies	**3 Hours**

Need for Hobbies in maintaining Work-Life Balance; how hobbies help in maintaining good physical and mental health, Various Hobbies

Habits

Difference between hobbies & habits, Cultivating good habits & discarding bad habits: Role of habits for a successful life, How habits form; Analyzing one's own habits; Recognizing useless & harmful habits, Cultivating & Sustaining useful habits

Peer pressure and How to cope with it	**3 Hours**

Human being as a Social Animal, Physical Pain & Social Pain; Awareness of Harmful Social Pressure, Role of Prefrontal Cortex in Judgement and Decision Making, why teenagers are vulnerable to peer pressure, strategies to overcome harmful peer pressure

Stress Management

Stress, Types of Stress, Fight & Flight Response of Humans; Harmful effects of chronic stress; Symptoms of Poor Coping Skills of Stress, Stress & Psychiatric problems, Easy coping strategies for stress

UNIT-III

Continuous & Lifelong Learning	**3 Hours**

Accelerated change in Technology Landscape, Shorter Life Cycles of Technologies, Need for Continuous Learning of other skills

Team Working Skills & Collaboration

Team Work – Meaning, Skills and Relevance, Importance of Collaboration to succeed in one's own career, How to be a good team member

Course Outcomes: At the end of the course student will be able to

1.	Apply the concept of Time Management, cope with Information Overload and withstand harmful peer pressure
2.	Comprehend the need to stay away from addictions by realizing the biological basis behind these concepts

3.	Develop good hobbies to maintain ideal work-life balance
4.	Develop the aptitude for finding creative solutions to problems and realize the importance of continuous and lifelong learning
5.	Demonstrate positive and progressive abilities

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1008-1.1	-	-	-	-	-	-	-	-	-	2	1	3	-	-
HU1008-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1008-1.3	-	-	-	-	-	-	-	-	-	3	1	3	-	-
HU1008-1.4	-	-	-	-	-	-	-	-	2	2	1	2	-	-
HU1008-1.5	-	-	-	-	-	-	-	-	1	2	1	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1.	Lieberman, D.E., “The Story of the Human Body”, Pantheon Books, 2013.
2.	Ratey, J.J., “Spark. Little Brown Spark”, 2013.
3.	De Bono, E., “Creative Thinking”, Penguin UK, 2016.
4.	Pachter, B., “The Power of Positive Confrontation”, Da Capo Lifelong Books, 1999.
5.	Duhigg, C., “The Power of Habit”, Random House Trade Paperbacks, 2012.
6.	Sharma, S., & Mishra, B., “Communication Skills for Engineers and Scientists”, PHI Learning, 2009.
7.	Tracy, B., “Time Management”, AMACOM, 2014.

INDIAN KNOWLEDGE SYSTEMS

Course Code:	**HU1009-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Enhance knowledge about the History of Ancient India and Rich Culture of the country
2.	Gain an introduction to ancient Indian Engineering Technology and Architecture
3.	Familiarize Indian indigenous wisdom in Modern scientific paradigm
4.	Understanding the Scientific Value of the Traditional Knowledge of our country
5.	Comprehend and compare the Ancient and Current Knowledge Systems

UNIT-I

Indian History — **6 Hours**

History - Land, Environment, and people in Ancient India; Ancient Education System, Takṣaśilā and Nālandā University, Hunting to Agriculture; Introduction to Vedas and Upanishads; Great Indian Epics; Indian Festivals

UNIT-II

Engineering, Technology, and Architecture — **6 Hours**

Pre-Harappan and Sindhu Valley Civilization, Laboratory and Apparatus, Juices, Dyes, Paints and Cements, Glass and Pottery, Metallurgy, Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Iron Pillar of Delhi, Rakhigarhi, Mehrgarh, Sindhu Valley Civilization, Marine Technology

UNIT-III

Science, Astronomy, and Mathematics — **3 Hours**

Concept of Matter, Life and Universe, Gravity, Sage Agastya's Model of Battery, Velocity of Light, Vimāna: Aeronautics, Vedic Cosmology and Modern Concepts, History and Culture of Astronomy, Sun, Earth, Moon, Eclipses, Rotation of Earth, Concepts of Zero and Pi, Number System, Pythagoras Theorem and Vedic Mathematics.

Course Outcomes: At the end of the course student will be able to

1.	Understand the relevance of studying history
2.	Comprehend the origin of Vedas and epics
3.	Realize the scientific value of the Traditional Knowledge of India
4.	Converting the Bhāratīya wisdom into the applied aspect of the modern scientific paradigm
5.	Preserve and disseminate Indian Knowledge Systems in Research and Societal applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1009-1.1	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1009-1.2	-	-	-	-	-	-	-	-	-	-	3	3	-	-
HU1009-1.3	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1009-1.4	-	-	-	-	-	-	-	-	-	-	2	2	-	-
HU1009-1.5	-	-	-	-	-	-	-	-	-	-	2	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1. Tripati, R.S., "History of Ancient India", Motilal Banarsidass, 1942.
2. Mahajan, V.D.. "Ancient India", S. Chand and Company, 1985.
3. Ramasubramanian, K., & Srinivas, M.D., "Development of Calculus in India", 2010.
4. Ramasubramanian, K., Srinivas, M.D., & Sriram, M.S., "The Traditional Indian Planetary Model and its Revision by Nilakantha Somayaji", 2011.
5. Srinivas, M.D., "Proofs in Indian Mathematics", Hindustan Book Agency, 2005.
6. Srinivas, M.D., "The Algorithmic Approach of Indian Mathematics", 2015.
7. Srinivas, M.D. "Indian Tradition of Science: An Introductory Overview", 2016.
8. Rahika, M., & Balasubramanian, A.V., "Ayurvedic Principles of Food and Nutrition", Part 1. Lok Swasthya Parampara Samvardhan Samithi, 1990.

PROJECT MANAGEMENT FOR PROFESSIONALS

Course Code	**MG1006-1**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S:J)	**3:0:0:0:2**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30+0+0+0+15**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course Learning Objectives

1	Understand the concepts of project management from planning to execution and how to apply them in projects.
2	Prepare the resource, schedule, cost planning for an industrial project.
3	Identify the risk and its management.
4	Usage of MS Project as a tool for project management and monitoring.

Unit -I

Contract Management and schedule Management	**Duration : 6 hrs**

Introduction to Project Management, Project and Project Lifecycle – Process, Phases, Organization, Project Financial Feasibility Methods, Non-numerical Feasibility Methods.

Basic Concepts of Contract Management, Essential elements, Contract Types, Tendering and Proposal Preparation, Key Commercial Terms and Conditions, Bid Evaluation and Contract Award, Contract Administration, Claim Management. Work Breakdown Structures- Creation & Case Study

Approach to schedule management, Charts, Sequencing and Dependency, Network Diagram, Activity Duration, Critical Path Method, Float, Case study, Relationships, Case Study, Precedence Diagramming Method.

Unit -II

Resource Management	**Duration : 6 Hrs**

Resource Allocation and Resource Levelling, Case Study on Schedule Compression, PERT to Predict the Probability of Project Completion.

Project Cost and Quality Management	**Duration : 6 Hrs**

Cost Estimation, Budget and Variance Analysis, Monitoring and Control, Cash Flows, Case Study.

Occupational Health, Safety and Environment, Barriers, Quality Management System – Chart and tools

UNIT-III

Procurement, Subcontracts and Stakeholder Management	**Duration : 6 Hrs**

Supply Chain Management, Logistics and Transportation, Vendor and Inventory Management. Stakeholder Analysis and Engagement, Project Communication, Dealing with Difficult Stakeholders

Project Risk Management and Project Monitoring	**Duration : 6 Hrs**

Process, Terminology, Identification, Analysis and Response Strategy
Analysis Techniques, Monitor and Control Schedule, Cost, Resources, Quality and risks
Creating schedules, Assigning Resources, Cost, Evaluation, Optimization and Tracking

Course Outcomes: At the end of the course student will be able to

1.	Develop WBS and estimate the resource requirements
2.	Prepare bar charts for work schedule
3.	Analyse the resource management methods
4.	Understand the quality control and safety during construction
5.	Create a project monitoring plan

TEXT BOOKS:

REFERENCE BOOKS:

1. Project management institute, Guide to the Project Management Body of Knowledge (PMBOK® Guide), seventh edition/2022.

Web links and Video Lectures (e-Resources):
L&T EduTech LMS Content

PO-CO mapping

Course Outcomes (CO)	**Program Outcomes (PO)**														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	1	2	3		2						2	1			
CO 2	1		3		2						2				
CO 3	1	3	2	2	1						1				
CO 4	1	1	3	1		2	1				2	1			

CO 5	1	2	3	1	2	1			1		3	1			

1: Low 2: Medium 3: High

EMPLOYABILITY SKILL DEVELOPMENT

Course Code:	**UM1003-1**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**00**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+00**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To explain the students the necessity of clearing the aptitude tests irrespective of the written test is for jobs or higher education.
2.	To assess the readiness of the students to appear for the aptitude test and assisting them to better it if already ready, else train them.
3.	To evaluate the understanding of the students in answering quantitative multiple-choice questions and guide them to improve it.
4.	To evaluate the preparedness of the students to answer the analytical and logical questions.
5.	To evaluate the quality of the students with regard to their professional language grammar, vocabulary and communication skills.

UNIT-I

Quantitative — **06 Hours**

Numbers (Odd, even, H.C.F & L.C.M, Square roots & cube roots, Average, Percentage), Ratios & Proportions, Partnership, Time & work, Pipes & Cistern, Speed, Problems on trains, Problems on boats & streams, Allegation & Mixtures.

UNIT-II

Analytical/ Logical — **06 Hours**

Numerical logic (next number in series, odd man out), Coded language, Syllogism, Direction (N-E-W-S), Seating arrangement, Blood relations, Statement & Conclusion

UNIT-III

Verbal — **03 Hours**

Vocabulary (root words, prefix, suffix, synonyms, antonyms), One word substitution, Idiom/phrases, Sentence completion, Active & Passive voice, Direct and indirect speech.

Course Outcomes: At the end of the course student will be able to

1.	Answer the quantitative multiple-choice questions.
2.	Analyse the analytical and logical questions.
3.	Improve the professional language grammar, vocabulary and communication skills.
4.	Clear the aptitude tests of any employer or higher educational institution.
5.	Advance in the chosen field of interest by appending aptitude skills with the technical skills

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
UM1003-1.1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**

UM1003-1.2	3	3	-	-	-	-	-	-	2	2	1	-	-	-	-
UM1003-1.3	3	3	2	-	-	-	-	-	2	2	1	-	-	-	-
UM1003-1.4	3	3	2	-	-	-	-	-	2	2	1	-	-	-	-
UM1003-1.5	3	3	2	-	-	-	-	-	2	2	1	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Aggarwal R.S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing.
2. Aggarwal R.S, "A modern approach to verbal and non-verbal reasoning", S Chand Publishing.

REFERENCE BOOKS:

1. Bharath Patodi and Aditya Choudhary, "Verbal Ability & Comprehension", Disha Publication, Second edition, 2015.
2. Shakuntala Devi, "Joy of numbers", Orient Black Swan.
3. Shakuntala Devi, "More puzzles to puzzle you", Orient Black Swan.

E Books / MOOCs/ NPTEL

1. https://www.indiabix.com
2. https://www.faceprep.in

ಆಡಳಿತ ಕನ್ನಡ (Kannada for Administration)

Course Code	**HU1003-1**	**Course Type**	**MNC**
Teaching Hours/Week (L:T:P:S)	**1:0:0:0**	**Credits**	**0**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+0**

Teaching Department: Any Department

Course Objectives:

1. ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
3. ಕನ್ನಡ ಭಾಷಾ ಬರೆಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗು ಅವುಗಳನಿವಾರಣೆ.
4. ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಡಿಸುವುದು.
5. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡ ದಪದಗಳ ಪರಿಚಯ ಮಾಡಿ ಕೊಡುವುಧು.

UNIT - I

ಲೇಖನಗಳು: 1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ: ಹಂಪನಾಗರಾಜಯ್ಯ 2. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ 3. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ವಿತಾವಿಯ ಆಡಳಿತ ಕನ್ನಡ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನ **ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕಪೂರ್ವ)** 1. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿಲಕ್ಕಮ್ಮ 2. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸ	**06 Hours**

3. ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳುಮನವೆ - ಕನಕದಾಸ
4. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳಸುಟ್ಟು - ಶಿಶುನಾಳಪಂಥಷರೀಫ
5. ಶಿವಯೋಗಿ: ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ
6. ಜನಪದಗೀತೆ: ಬೀಸುವಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

UNIT – II

ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ)

1. ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ: ಡಿ.ವಿ.ಜಿ.
2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ.ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು
4. ಹೆಂಡತಿಯ ಕಾಗದ: ಕೆ .ಎಸ್. ನರಸಿಂಹಸ್ವಾಮಿ
5. ಮಬ್ಬಿನಿಂದ ಮಬ್ಬಿಗೆ: ಜಿ. ಎಸ್. ಶಿವರುದ್ರಪ್ಪ
6. ಆಮರ ಈ ಮರ: ಚಂದ್ರಶೇಖರ ಕಂಬಾರ
7. ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು: ಸಿದ್ಧಲಿಂಗಯ್ಯ

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

1. ಡಾ. ಸ ರ್ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ: ಎ ಎನ್ಮೂರ್ತಿ ರಾವ್
2. ಯುಗಾದಿ: ವಸುಧೇಂದ್ರ
3. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

06 Hours

UNIT – III

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ:

1. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ: ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ
2. 'ಕ' ಮತ್ತು 'ಬ' ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು ಕನ್ನಡ ಟೈಪಿಂಗ್
3. ಕನ್ನಡ: ಕಂಪ್ಯೂಟರ್ಶಬ್ದಕೋಶ
4. ತಾಂತ್ರಿಕ ಪದಕೋಶ: ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

03 Hours

Course Outcomes: At the end of the course student will be able to

1.	ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡುನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2.	ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
3.	ಕನ್ನಡ ಭಾಷಾ ಬರೆಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗು ಅವುಗಳ ನಿವಾರಣೆ.
4.	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
5.	ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುಧು.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
HU1003-1.1	-	-	-	-	-	-	-	**3**	-	-	**1**	**1**	-	-	-

HU1003-1.2	-	-	-	-	-	-	-	2	-	-	1	1	-	-	-
HU1003-1.3	-	-	2	-	-	-	1	2	-	-	1	1	-	-	-
HU1003-1.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
HU1003-1.5	-	-	1	-	-	-	-	3	-	-	1	1	-	-	-

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	ಸಂಕ್ಷಿಪ್ತ ಕನ್ನಡನಿಗಂಟು (ಪರಿಷ್ಕೃತ), ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
2.	ಆಡಳಿತ ಪದಕೋಶ, ಕನ್ನಡ ಅಭಿವೃದ್ಧಿಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು.
3.	ಕಾನೂನು ಪದಕೋಶ (ಪರಿಷ್ಕೃತ) ಕನ್ನಡ- ಇಂಗ್ಲಿಷ್, ಕನ್ನಡ ಮತ್ತು ಸಂಸ್ಕೃತಿ ನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು.
4.	ಡಿ.ಎನ್. ಶಂಕರ್ಭಟ್, ಕನ್ನಡವಾಕ್ಯಗಳ ಒಳರಚನೆ, ೨೦೦೬, ಭಾಷಾಪ್ರಕಾಶನ, ಮೈಸೂರು.
5.	ಕನ್ನಡ ಭಾಷಿಕ (ಅವಿಸ್ತರ)- ಪ್ರಬಂಧ ಮತ್ತು ಆಡಳಿತ ಕನ್ನಡ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಮೈಸೂರು.
6.	ಆಡಳಿತ ಕನ್ನಡ, ಎಚ್ಚೆಸ್ಕೆ, ಚೇತನ ಬುಕ್ಹೌಸ್, ಮೈಸೂರು.

Balake Kannada (Communication in Kannada)

Course Code	**HU1003-1**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**0**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+0**

Teaching Department: Any Department

Course Objectives:

1.	The course will enable the students to cognize Kannada and communicate in basic Kannada language.

UNIT - I

Basic Kannada Grammar Personal Pronouns, Possessive Forms, Interrogative words Possessive forms of nouns, Dubitive question and Relative nouns Qualitative, Quantitative and Colour Adjectives, Numerals Predictive Forms, Locative Case Dative Cases, and Numerals Ordinal numerals and Plural markers Defective / Negative Verbs and Colour Adjectives Permission, Commands, encouraging and Urging words (Imperative words and sentences) Accusative Cases and Potential Forms used in General Communication Helping Verbs “iru and iralla”, Corresponding Future and Negation Verbs Comparative, Relationship, Identification and Negation Words Different types of forms of Tense, Time and Verbs Formation of Past, Future and Present Tense Sentences with Verb Forms Karnataka State and General Information about the State Kannada Language and Literature Do's and Don'ts in Learning a Language	**06 Hours**

UNIT – II

Kannada Language Script Part – 1	**06 Hours**
UNIT – III	
Kannada Vocabulary List & Kannada Words in Conversation	**03 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Understand the parts of speech of Kannada
2.	Know the script in Kannada
3.	Able to Converse daily usages in Kannada
4.	Enrich Basic Kannada Vocabulary
5.	Have knowledge about Karnataka and its culture

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
HU1003-1.1	-	-	-	-	-	-	-	**3**	-	-	**1**	**1**	-	-	-
HU1003-1.2	-	-	-	-	-	-	-	**2**	-	-	**1**	**1**	-	-	-
HU1003-1.3	-	-	**2**	-	-	-	**1**	**2**	-	-	**1**	**1**	-	-	-
HU1003-1.4	-	-	-	-	-	-	-	**1**	-	-	-	-	-	-	-
HU1003-1.5	-	-	**1**	-	-	-	-	**3**	-	-	**1**	**1**	-	-	-

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	English –Kannada Rapidex Dictionary of Spoken Words, S N Raju, Bengaluru
2.	English Kannada Standard Dictionary, D K Bharadwaj, Sankeshwar Printers Pvt Ltd, Bengaluru
3.	ಮಾತಾಡುವ ಕನ್ನಡ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು (೨೦೧೬).
4.	ಸಂಕ್ಷಿಪ್ತ ಕನ್ನಡನಿಗಂಟು (ಪರಿಷ್ಕೃತ), ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
5.	ಆಡಳಿತ ಪದಕೋಶ, ಕನ್ನಡ ಅಭಿವೃದ್ಧಿಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು.
6.	ಕನ್ನಡ ಭಾಷಾಕೈಪಿಡಿ, ಸಂಗಮೇಶ್ವವ ದತ್ತಿಮಠ, ರೂಪರಶ್ಮಿ ಪ್ರಕಾಶನ, ಗುಲ್ಬರ್ಗ, ೧೯೯೫.
7.	ಡಿ.ಎನ್. ಶಂಕರ್ಭಟ್, ಕನ್ನಡ ವಾಕ್ಯಗಳ ಒಳ ರಚನೆ, ೨೦೦೬, ಭಾಷಾ ಪ್ರಕಾಶನ, ಮೈಸೂರು.
8.	ಕಾನೂನು ಪದಕೋಶ (ಪರಿಷ್ಕೃತ) ಕನ್ನಡ- ಇಂಗ್ಲಿಷ್, ಕನ್ನಡ ಮತ್ತು ಸಂಸ್ಕೃತಿ ನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು.

Engineering Economics & Financial Management

Course Code:	**MG1009-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Analyse the time value of money.
2.	Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost-benefit analysis).
3.	Take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
4.	Determine the depreciated values of assets and also cost involved in each operation, a product should undergo with an aim to fix suitable selling price for the products.

5.	Know the fundamentals of Financial Management.

UNIT-I	
Fundamental economic concepts Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns(No exercises)	**07 Hours**
Interest Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].	**07 Hours**
UNIT-II	
Economic Analysis of Alternatives Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Equivalent Annual Worth, Exercises. Analysis based on Rate of Return, Exercises.	**09 Hours**
Depreciation Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance] Exercises.	**04 Hours**
Estimating and Costing Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises**.**	**03 Hours**
UNIT-III	
Financial management Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.	**05 Hours**
Working Capital Management: Factors influencing working capital requirement, determination of operating cycle and working capital. **Capital Budgeting:** Risk analysis in Capital Budgeting	**05 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Explain the fundamental economic concepts.
2.	Use simple interest and compound interest to determine compounded and discounted amount.
3.	Compare the alternatives using Present Worth, Equivalent Annual Worth, Future Worth and IRR methods.
4.	Calculate the depreciated amount of a given assets using Straight line, Declining balance, Double declining g balance method. Estimate the selling price of given product.

5.	Prepare Balance Sheet & Profit and Loss account for given data of a firm. Estimate working capital. Explain capital budgeting.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
MG1009-1.1	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**
MG1009-1.2	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**
MG1009-1.3	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**
MG1009-1.4	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**
MG1009-1.5	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004
2. Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012.
3. Financial Management, I M Pandey, Vikas Publishing House, 2002

REFERENCE BOOKS:

1. Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001.
2. Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.
3. Engineering Economics, Tarachand, Nemchand & Bros, 1996.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/courses/112107209/

University Core Courses

Internship-I (Activity Based)			
Course Code	**UC2001-1**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**-**	**SEE Marks**	**-**
Total Hours of Pedagogy	**-**	**Total Marks**	**50**

Credits	**8**	**Exam Hours**	**3**

Course objective

1. This course is meant to provide students an avenue to understand the work environment in an industry/organization and take up assignments/jobs in the future.

Course outcomes

1. Experience the working in an industry/organization and understand the influence of engineering solutions in general.
2. Work in teams and communicate efficiently both written and oral.
3. Develop the ability to do research, understand things and engage in life-long learning.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
UC2001-1.1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**1**	**1**	**1**
UC2001-1.2	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**1**	**1**	**1**
UC2001-1.3	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**1**	**1**	**1**
1: Low 2: Medium 3: High															

Major Project Phase –I & II

Course Code	**UC3001-1 & UC3002-1**	**CIE Marks**	100 +100
Teaching Hours/Week (L:T:P: S)	-	**SEE Marks**	0+100
Total Hours of Pedagogy	-	**Total Marks**	300
Credits	10	**Exam Hours**	0+3

The project work involves the following:

A report highlighting the design finalization [based on functional requirements & standards (if any)]
Fabrication, assembly, testing and performance analysis of the designed project
A presentation including Implementation Phase (Hardware / Software / both), Testing & Validation of the developed system, Learning in the Project and Consolidated report preparation

Course objectives:

To expose engineering students to technology development at workplaces and appraise them regarding shop-floor problems.
To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking Programme.
During this work bench involvement, students will be given 3-4 practical problems. The problems assigned should be of mutual interest to the students and the industry. The problem may belong to 3 or 4 different functional areas.
To illustrate, following are some of the suggestions:
Design of a prototype¨ Programming of CNC machines¨ Calibration and testing of instruments ¨ Productivity Improvement Studies¨ Pollution control related problems¨ Capacity Planning and Capital

Budgeting¨ Safety Management¨ Optimum utilization of resources¨ Conflict Management methodology. The industrial organizations where students are to be sent for problem solving project-oriented work bench involvement may be selected well in advance¨ The faculty of the department is expected to visit the selected industries and identify suitable problems to be handled by students. It will be desirable that problems be matched with the interests of students.
It is recommended that a group of 5-6 students be guided by one faculty member during this period.

Course outcome (Course Skill Set)

At the end of the course student will be able to

UC3001-1.1 Create a model/prototype through fabrication, simulation, data analysis, Experimentation
UC3001-1.2 Compose a technical paper/propose an idea and defend its novelty and suitability to the current need of the society/industry
UC3001-1.3 Prepare a technical report and demonstrate the project work through oral presentation.

Assessment Details (both CIE and SEE)

CIE procedure for project phase II is same as that of project phase I
Semester End Examination:
SEE procedure:
i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.
ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.
SCHEME OF EVALUATION:
Project demonstration, Viva voce
Total marks: 100 Marks
The distribution of marks shall be proportioned based on the type of the project and it is based on fulfilling the following requisites.
The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- Punctuality and Attendance ¨ Interpersonal relations
- Sense of Responsibility
- Clarity of concepts, principles and procedures
- Self-expression/communication skills
- Report Writing Skills
- Creativity/conceiving new and unusual ideas
- Problem-solving skills

At the end of the project work course students are required to submit a working model of the equipment they have designed and developed or if it is a theoretical or experimental work, they are expected to study a detailed analysis and findings from their work.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
UC3001&2-1.1	**-**	**-**	**-**	**2**	**3**	**1**	**1**	**1**	**3**	**1**	**1**	**2**	**-**	**-**	**-**
UC3001&2-1.2	**-**	**-**	**-**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
UC3001&2-1.3	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**
1: Low 2: Medium 3: High															

Open Elective Courses

Sl No.	Department	Course Codes	Open Elective Courses
1	BT	BT1501-1	Bio Fuel Engineering
2	BT	BT1502-1	Solid Waste Management
3	CS	CS2501-1	Fundamentals of AI and ML
4	CS	CS2502-1	Introduction to Data Structures
5	CV	CV2501-1	Disaster Management
6	CV	CV2502-1	Environmental Hygiene, Sanitation and Waste Management
7	CV	CV2503-1	Environmental Impact Assessment
8	CV	CV2504-1	Introduction to Geoinformatics
9	CY	CY2501-1	Corrosion Science (Only for CV and ME)
10	CY	CY2502-1	Natural Products Chemistry (Only For BT)
11	EC	EC1501-1	Artificial Neural Network Systems
12	EC	EC1502-1	Introduction to MATLAB Programming: A Hands-on Approach (only for CV and BT)
13	EC	EC1503-1	Robotics
14	EC	EC2501-1	Consumer Electronics
15	EC	EC2502-1	PCB Design and Fabrication
16	EC	EC2503-1	Space Technology and Applications
17	EE	EE2501-1	Battery Management System
18	EE	EE2502-1	Biomedical Instrumentation
19	EE	EE2503-1	Electric Vehicle Technology
20	EE	EE2504-1	Fundamentals of PLC and its applications
21	EE	EE2505-1	Motors and Motor Control Circuits
22	EE	EE2506-1	Non-Conventional Energy sources
23	HU	HU1501-1	Elements of Yoga
24	HU	HU1502-1	Intellectual Property Rights
25	HU	HU1503-1	Introduction to German Language
26	HU	HU1504-1	Introduction to Japanese Language
27	HU	HU1505-1	National Cadet Corps: Organization, Functions & Capabilities
28	HU	HU1506-1	Overview of Indian Culture
29	HU	HU1507-1	Philosophy
30	HU	HU1508-1	Principles of Physical Education
31	HU	HU1509-1	Indian Culture – Dance *
32	HU	HU1510-1	Indian Culture – Music *
33	HU	HU1511-1	Engineering Ethics *
34	HU	HU1512-1	Art of Communication and Interpersonal Skills*
35	HU	HU2501-1	Common sense and Critical Thinking
36	HU	HU2502-1	Linguistics & Language Technology
37	IS	IS2501-1	Introduction to Cyber Security (except EC, EE, AM, AD, CC, CS, IS)
38	IS	IS2502-1	Python Application Programming
39	IS	IS2503-1	Software Engineering Practices
40	IS	IS2504-1	Web technologies
41	MA	MA1501-1	Graph Theory (for BT, CV, EC, EE, ME and RI)
42	MA	MA1502-1	Number Theory
43	MA	MA3501-1	Linear Algebra (for BT, CV, EE, ME and RI)
44	ME	ME1501-1	Automotive Engineering
45	ME	ME1502-1	Industrial Pollution Control
46	ME	ME1503-1	Sustainable Development Goals
47	ME	ME1504-1	Technology Innovation
48	MG	MG1501-1	Human Resource Management
49	MG	MG1502-1	Management Accounting and Control Systems
50	MG	MG1503-1	Operations and Quality Management
51	MG	MG1504-1	Organizational Behaviour

52	MG	MG1505-1	Taxation for Engineers
53	MG	MG1506-1	Working Capital Management
54	PH	PH2501-1	Nanotechnology
55	PH	PH2502-1	Optoelectronic Devices (EC, EE, CSE, ISE, AM and CC branches)
56	RI	RI2501-1	Autonomous Mobile Robots
57	RI	RI2502-1	Medical Robotics (for all except AI)
58	RI	RI2503-1	PLC Control of Hydraulic and Pneumatic Circuits (for all except AI)

*** For students admitted under Twinning Program**

BIOFUEL ENGINEERING

Course Code:	**BT1501-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn the fundamental concepts of biofuels, types of biofuels, their production technologies.
2.	To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT-I

Liquid Biofuels — **15 Hours**

Description and classification of Biofuels; Primary biomass: Plant Materials-Woody biomass, Lignocellulosic and agroindustrial by-products, starchy and sugary crops. Secondary biomass: Waste residues and co-products- wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate).

Production of biodiesel: Sources of Oils – edible and non-edible; Esterification and Transesterification. Free fatty acids; saponification; Single step and two step biodiesel production. Catalysts for biodiesel production – homogeneous (alkali/acidic) and heterogeneous; Lipase mediated process. General procedure of biodiesel production and purification Quality Control Aspects: GC analysis of biodiesel, fuel property measurements, ASTM (D-6751) and Indian standards (IS15607). Algal Biodiesel production.

Production of Bioethanol: Bioethanol production using Sugar; Starch and Lignocellulosic feedstocks; Pretreatment of lignocellulosic feed stock

UNIT-II

Biohydrogen and Microbial Fuel Cells — **15 Hours**

Enzymes involved in H_2 Production; Photobiological H_2 Production: Biophotolysis and Photo fermentation; H_2 Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H_2 production, Carbon sources, Detection and Quantification of H_2. Reactors for biohydrogen production.

Microbial Fuel cells: Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness;

Advances in MFC.

UNIT-III

Recovery of Biological Conversion Products — **10 Hours**

Bio gasification of municipal solid waste: Anaerobic processing; Types of digesters, Biogas plant in India.

Thermochemical processing: Planning an incineration facility, Incineration technologies: Mass burning system; Refuse derived fuel (RDF) system; modular incineration; Fluidized bed incineration; energy recovery; Fuel production through biomass incineration, Pyrolysis and gasification, hydrothermal processing.

Course Outcomes: At the end of the course student will be able to

1.	Mark the significance of biofuels and raw materials and Identify suitable feedstock for production of biofuels.
2.	Illustrate the production of liquid biofuels from various feed stocks.
3.	Demonstrate production of biohydrogen using microbial sources.
4.	Extend the concepts of microbial fuel cells towards development of specific application.
5.	Understand and apply the concepts of biochemical processing to harvest energy from waste products/streams.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BT1501-1.1	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.2	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.3	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.4	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.5	-	2	-	-	-	-	-	-	1	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Drapcho, C. M., Nhuan, N. P. and Walker, T. H. , "Biofuels Engineering Process Technology", Mc Graw Hill Publishers, New York, 2008.
2.	Jonathan R.M, Biofuels, "Methods and Protocols (Methods in Molecular Biology Series)", Humana Press, New York, 2009.
3.	Olsson L. (Ed.), "Biofuels (Advances in Biochemical Engineering/Biotechnology Series", Springer-Verlag Publishers, Berlin, 2007.
4.	Glazer, A. and Nikaido, H., "Microbial Biotechnology – Fundamentals of Applied Microbiology", 2 Ed., Cambridge University Press, 2007.
5.	Godfrey Boyle (Ed). "Renewable Energy- Power for sustainable future", 3rd Ed. Oxford. 2012.
6.	Ramachandran, T. V., "Management of municipal solid waste", Environmental Engineering Series. Teri Press, 2016.

SOLID WASTE MANAGEMENT

Course Code:	**BT1502-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn types of solid wastes, collection, treatment and disposal methods.
2.	To understand various processing techniques and regulations of treatment and disposal.

UNIT-I

Introduction to Solid Wastes and its Segregation & Transportation	**15 Hours**

Solid waste – Definition, Sources of waste, Classification of Solid waste, Characteristics of Solid Waste (Physical, Chemical, Biological), Solid waste problems – impact on environment and health. Concept of waste reduction, recycling and reuse.

Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipment used and manpower required in collection, Collection systems and routes.

Transportation: Transfer stations: types, location, maintenance, Methods and means of transportation.

UNIT-II

Processing Techniques, Recovery of Resources and Waste Disposal	**15 Hours**

Processing Techniques: Unit operations for separations and processing, mechanical and thermal volume reduction, Incineration of solid wastes – process and types of incinerators (liquid injection, rotary kiln and fluid bed), Biological processing – composting, vermicomposting, biomethanation, fermentation, Drying and dewatering of wastes.

Recovery of Resources: Heat recovery in incineration process, energy recovery and conversion of products from biological processes.

Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes, biomedical waste.

UNIT-III

Solid Waste Management Rules and Planning Issues	**10 Hours**

Legislative trends and impacts: Major legislations, Government agencies. Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2011.

Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.

Course Outcomes: At the end of the course student will be able to

1.	Identify the sources, classification and characteristics of solid wastes
2.	Develop insight into the collection, transfer, and transport of solid waste.

3.	Apply waste processing techniques and recovery of resources from the waste.
4.	Select the alternatives of solid waste disposals and its impacts.
5.	Acquire knowledge about solid and hazardous waste management legislative rules.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BT1502-1.1	1	-	-	-	-	-	-	-	1	-	-	-
BT1502-1.2	1	1	-	-	-	1	1	-	1	-	-	-
BT1502-1.3	-	2	-	-	-	-	-	-	1	-	-	-
BT1502-1.4	-	2	-	-	-	1	1	-	1	-	-	-
BT1502-1.5	1	-	-	-	-	-	-	-	1	-	-	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Tchobanaglous, G., Theisen, H. and Vigil, S. A. "Integrated Solid Waste Management", McGraw – Hill. 1993.
2.	Tchobanoglous, G., Thiesen, H., Ellasen, "Solid Waste Engineering Principles and Management", McGraw – Hill, 1997.
3.	Landrefh, R. E. and Sundaresan, B. B. "Solid Waste Management in Developing Countries", Indian National Scientific Documentation Centre. New Delhi, 2000.

FUNDAMENTALS OF AI AND ML

Course Code:	**CS2501-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50**
Prerequisite	**CS1002-1**		

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Analyze the most fundamental knowledge to the students so that they can understand what the AI is.
2.	Gain a historical perspective of AI and its foundations
3.	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4.	Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool.
5.	Explore the current scope, potential, limitations, and implications of intelligent systems.

UNIT-I

Introduction	**15 Hours**

What is AI? Foundation of AI, Early History of AI, The Middle Ages and Dark Ages of AI, Renaissance, Future of AI.

Intelligence of AI

AI An Impossible Task, Animal Intelligence, Brain Size And Performance, Sensing And Movement, Subjective Intelligence, Iq Tests. Comparative Intelligence,

Chapter No 1: Introduction and Intelligence (Page No 11-37)

UNIT-II

Classical Artificial Intelligence	**15 Hours**

Introduction, Expert Systems, Conflict Resolution, Multiple Rules, Forward Chaining, Backward Chaining, Problems With Expert Systems, Fuzzy Logic, Fuzzification, Fuzzy Rules, Defuzzification, Fuzzy Expert System, Problem Solving. Chapter No 2: Classical AI (Page No 38-45)

UNIT-III

Foundations of Machine Learning	**10 Hours**

What is machine learning? Applications of Machine learning, Understand Data, Types of machine learning: Supervised, Unsupervised, Reinforcement Learning, Theory of learning: feasibility of learning, error and noise, training versus testing, theory of generalization, bias and variance, learning curve,.

Course Outcomes: At the end of the course student will be able to

1.	Explain the fundamental understanding of the history of artificial intelligence (AI) and its foundation
2.	Interpret the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3.	Describe the awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models
4.	Identify and explain the proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
5.	Explain the fundamental concept and importance of machine learning.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CS2501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.2	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.3	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.4	3	3	2	-	-	-	-	-	-	-	-	-
CS2501-1.5	3	3	2	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kevin Warwick, "Artificial Intelligence the basics", Typeset in Bembo by Wearset Ltd, Boldon, Tyne and Wear, Library of Congress Cataloging in Publication Data Warwick, K. ISBN: 978-0-415-56482-3 (hbk).

REFERENCE BOOKS:

1.	Stuart Russel and Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson 3rd Edition , 2016.
2.	Dan W Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson, 1st edition 2015.
3.	Elaine Rich, "Artificial Intelligence", Mc Graw Hill 3rd Edition, 2017.

E Books / MOOCs/ NPTEL

1.	Practical Artificial Intelligence Programming With Java, Third Edition ,Mark Watson
2.	Artificial Intelligence -http://www.nptelvideos.in/2012/11/artificial-intelligence.html
3.	http://nptel.ac.in/courses/106105077/
4.	https://www.udemy.com/artificial-intelligence
5.	https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

INTRODUCTION TO DATA STRUCTURES

Course Code:	**CS2502-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L:T:P:S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50**
Prerequisite	**CS1001-1**		

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Outline the concepts of data structures, types, operations, structures, pointers
2.	Implement linear data structures stacks, queues and usage of stacks in various applications.
3.	Implement the operations of singly linked lists
4.	Identify and differentiate different types of binary trees and binary search trees data structures
5.	Illustrate and classify threaded binary trees.

UNIT-I

Introduction	**15 Hours**
Data Structure, Classification (Primitive and non-primitive), data structure operations, Arrays, Pointers and structures, Dynamic Memory Allocation Functions,	
Linear Data Structures – Stacks	
Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks,	
Applications of Stack	
Conversion of Expressions, Evaluation of expressions, Recursion: Implementation, Simulating Recursion, examples on Recursion.	

UNIT-II

Linear Data Structures – Queues	**15 Hours**
Introduction and Definition Representation of Queue: Array and Structure, representation of Queue, Various queue structures: ordinary queue, circular Queue	
Linear Data Structures - Linked Lists	
Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List, Circular Linked List, Doubly Linked List: Representation and Operations, Circular doubly Link list: Representation and Operations.	

UNIT-III

Nonlinear Data Structures- Tree Data Structures	**10 Hours**
Basic Terminologies, Binary Trees: Properties, Representation of Binary Tree: Linear representation, Linked representation, Operations on Binary Tree: Insertion, traversals. Introduction to Binary Search Tree	

Course Outcomes: At the end of the course student will be able to

1.	Acquire the fundamental knowledge of various types of data structures and pointers.
2.	Apply the fundamental programming knowledge of data structures to design stack and use them for solving problems.
3.	Apply the fundamental programming knowledge of data structures to design queues and use them for solving problems.
4.	Design various functions for implementation of linked list.
5.	Implement and apply the concept of binary trees and binary search tree data structure.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CS2502-1.1	-	-	-	-	-	-	-	-	-	-	-	-
CS2502-1.2	3	1	2	-	-	-	-	1	-	-	-	1
CS2502-1.3	3	2	2	-	-	-	-	1	-	-	-	1
CS2502-1.4	3	2	-	-	-	-	-	1	-	-	-	1
CS2502-1.5	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Aaron M. Tenenbaum, Yedidyah Langsam& Moshe J. Augenstein, "Data Structures using C", Pearson Education/PHI, 2009.
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2014.

REFERENCE BOOKS:

1. Seymour Lipschutz, "Data Structures, Schaum's Outlines", Revised 1st edition, McGraw Hill, 2014.

E Books / MOOCs/ NPTEL

1. Data Structures Using C, ISRD Group, Tata McGraw Hill, 2006.
2. Data Structures Using C, Reema Thareja, 2nd edition, Oxford University Press, 2014
3. Introduction to Data Structures by edx , URL: https://www.edx.org/course/
4. Data structures by Berkley, URL: https://people.eecs.berkeley
5. Advance Data Structures by MIT OCW , URL: https://www.mooclab.club/
6. Data Structure by Harvard Extension School, URL: http://www.extension.harvard.

DISASTER MANAGEMENT

Course Code:	**CV2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CV1002-1**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand difference between Disaster, Hazard, Vulnerability, and Risk.
2.	Know the Types, Trends, Causes, Consequences and Control of Disasters
3.	Apprehend Disaster Management Cycle and Framework.
4.	Know the Disaster Management in India
5.	Appreciate Applications of Science and Technology for Disaster Management.

UNIT-I

Understanding Disasters	**04 Hours**
Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.	
Types, Trends, Causes, Consequences and Control of Disasters	**10 Hours**
Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters	

UNIT-II

Disaster Management Cycle and Framework	**10 Hours**
Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.	
Disaster Management in India	**06 Hours**
Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies.	

UNIT-III

Applications of Science and Technology for Disaster Management	**06 Hours**
Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India	
Case Studies	**04 Hours**
Study of Recent Disasters (at local, state and national level), Preparation of Disaster Risk Management Plan of an Area or Sector, Role of Engineers in Disaster Management	

Course Outcomes: At the end of the course student will be able to

1.	Explain Concepts, Types, Trends, Causes of Disasters
2.	Describe Consequences and Control of Disasters
3.	Explain Disaster Management Cycle and Framework
4.	Explain the lesson learnt from the disasters in India and discuss the financial mechanism, roles and responsibilities of Non-Government and Inter-Governmental Agencies for Disaster management
5.	Describe the Applications of Science and Technology recent disasters, role of engineers for Disaster Management and prepare a report of Disaster Risk Management Plan.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CV2501-1.1	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.2	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.3	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.4	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.5	-	-	-	-	-	3	2	-	-	-	1	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Noble, L. , "Introduction to environmental impact assessment. A Guide to Principles and Practice", 2nd edition, Oxford University Press, Don Mills, Ontario, 2010.
2.	Larry W. Canter, "Environmental Impact Assessment", McGraw Hill Inc. Singapore, 1996.

REFERENCE BOOKS:

1.	Morris and Therivel, "Methods of Environmental Impact Assessment", 3rd edition. New York, NY: Routledge, 2009.
2.	Hanna, K. S., "Environmental impact assessment", Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario, 2009.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/120108004/
2.	http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

ENVIRONMENTAL HYGIENE, SANITATION AND WASTE MANAGEMENT

Course Code:	**CV2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CV1002-1**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Creation of awareness among student's health issues and Swachh Bharath mission and the consequent responsibilities.
2.	To understand the culture cleanliness, engineering applications in creation of ODF (Open defecation free) concept, Importance of legal & cultural issues related to Environmental Hygiene.
3.	To know the importance of sanitation, gender sensitive sanitation issues & use of engineering technology in construction of toilets.

4.	To know the importance of waste management system, wastewater audit and waste water treatment process.
5.	To study the role of student in Swachh Bharata Abhiyan, solid and waste water treatment process.

UNIT-I	
Prospective: Environmental Hygiene (EH), Sanitation, Solid Waste and Wastewater	**06 Hours**
Introduction- Swachh Bharath Mission (SBM)-Mission Objectives-Duration- Components Environmental Hygiene-Benefits-Sanitation-Waste Management. Work opportunities in Environmental Hygiene, Sanitation and Waste Management. Participatory Learning for Environmental Hygiene, Sanitation and Waste Management.	
Sociology of environmental hygiene management, solid waste and waste water and impacts	**08 Hours**
Open Defecation-Habits & attitude towards waste-Goals of SBA. Community Consciousness and Engagement on Sanitation Aspects, Roles & Responsibilities, Job Charts, Frequency, Schedules and Timelines in Swachhata Management, Culture of Cleanliness (Swachh Bharat Abhiyan), Behaviour Change Communication, Role of Habits and Attitudes in Environmental Hygiene Management, Waste and Wastewater Disposal; Change Management.	
UNIT-II	
Infrastructure for Sanitation	**08 Hours**
Containment-Preparation of toilets –Toilet Types Evaluation of Construction and Maintenance of Community, Public, Institutional and Individual Sanitation Infrastructure Toilets-Proportion and Number of toilets, Gender Sensitive Sanitation Facilities, Ramps for Differently Abled, Types – Indian and Western. Faecal Sludge treatment - Single / Twin pit, Eco San, Septic Tank and Formal Sewerage.	
Solid Waste Management	**08 Hours**
Swachh Survekshan- Solid Waste management- Steps- Waste Audit-Classification Methods of Solid Waste Disposal and Management-Composting-Different types of composting- Waste Minimization-Waste Management.	
UNIT-III	
Waste & Wastewater Audit	**06 Hours**
Waste Audit -Environmental Impact Assessment, Waste Characterization, Quantity Determination, Primary Collection Methods, Secondary Transportation. **Wastewater Audit**-Water Budget, Types of Wastewater, Survey of Distribution Network and Feasibility of Various Wastewater Treatment Methods.	
Swachh Bharath Mission and Inclusivity	**04 Hours**
Swacch Bharath Mission in rural & Urban Context-Gender Issues in sanitation. Role of women in Sanitation.	

Course Outcomes: At the end of the course student will be able to

1.	Creation of awareness among student's health issues and Swachh Bharath mission and the consequent responsibilities.
2.	To understand the culture cleanliness, engineering applications in creation of ODF (Open defecation free) concept, Importance of legal & cultural issues related to Environmental Hygiene.
3.	To know the importance of sanitation, gender sensitive sanitation issues & use of engineering technology in construction of toilets.

4.	To know the importance of waste management system, wastewater audit and waste water treatment process.
5.	To study the role of student in Swachh Bharata Abhiyan, solid and waste water treatment process.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CV2502-1.1	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.2	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.3	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.4	1	1	-	-	-	2	3	2	-	3	-	-
CV2502-1.5	1	1	-	3	-	2	3	2	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Joanne E. Drinan and Frank Spellman, "Water and Wastewater Treatment: A Guide for the Non-engineering Professional".
2.	M. S. Bhatt and Asheref Illiyan, "Solid Waste Management: An Indian Perspective".
3.	Jagbir Singh, "Solid Waste Management: Present and Future Challenges".
4.	M. S. Bhatt, "Solid Waste Management: An Indian Perspective".
5.	T. V. Ramachandra, "Management of Municipal Solid Waste".
6.	Syed R. Qasim, "Wastewater Treatment Plants: Planning, Design and Operation".

REFERENCE BOOKS:

1.	Swachhbharatmission.gov.in/
2.	https://www.india.gov.in//swachh-bharat-mission-gramin-portal
3.	https://www.swachhsurvekshan2018.org/
4.	https://zerowasteeurope,eu/
5.	www.zerowasteindia.in/

E Books / MOOCs/ NPTEL

1.	http://www.un.org/waterforlifedecade/pdf/award_south_africa_eng_for_web.pdf
2.	http://www.sulabhinternational.org
3.	http://swachhbharatmission.gov.in/sbmcms/writereaddata/images/pdf/Guidelines /Complete-set-guidelines.pdf

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code:	**CV2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CV1002-1**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Identify the need to assess and evaluate the impact of projects on environment.
2.	Explain major principles of environmental impact assessment.
3.	Understand the different steps within environmental impact assessment.
4.	Appreciate the importance of EIA for sustainable development and a healthy environment.

UNIT-I

Evolution of EIA **16 Hours**

Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA, General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.

UNIT-II

14 Hours

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.

UNIT-III

10 Hours

Fault free analysis, Consequence Analysis, Introduction to Environmental Management Systems, Environmental management plan-Post project monitoring Environmental Audit: Cost Benefit Analysis, Life cycle Assessment. Case studies on project, regional and sectoral EIA.

Course Outcomes: At the end of the course student will be able to

1.	Understand phenomena of impacts and know the impact quantification of various projects in the environment.
2.	Liaise with and list the importance of stakeholders in the EIA process.
3.	Know the role of public in EIA studies.
4.	Overview and assess risks posing threats to the environment.
5.	Assess different case studies/examples of EIA in practice.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CV2503-1.1	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.2	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.3	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.4	1	1	-	-	-	2	3	2	-	3	-	-
CV2503-1.5	1	1	-	3	-	2	3	2	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Noble, L., "Introduction to environmental impact assessment. A Guide to Principles and Practice", 2nd edition, Oxford University Press, Don Mills, Ontario, 2010.
2.	Larry W. Canter, "Environmental Impact Assessment", McGraw Hill Inc. Singapore, 1996.
REFERENCE BOOKS:	
1.	Morris and Therivel, "Methods of Environmental Impact Assessment", 3rd edition. New York, NY: Routledge, 2009.
2.	Hanna, K. S., "Environmental impact assessment. Practice and Participation". 2nd edition. Oxford, University Press, Don Mills, Ontario, 2009.
E Books / MOOCs/ NPTEL	
1.	http://nptel.ac.in/courses/120108004/
2.	http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

INTRODUCTION TO GEOINFORMATICS

Course Code:	**CV2504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T: P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CV1001-1, CV1002-1**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Explain the basic principles of Geoinformatics comprising Remote sensing, Photogrammetry, GPS, GNSS & GIS.
2.	Explain the stages and techniques of photogrammetry, aerial photo interpretation, visual & digital image processing, enhancement and interpretation.
3.	Explain and Appraise GIS - its components, data structures, process and operation, Map and its projections, components, preparation and overlays
4.	Explain the GIS functionality and Appraise the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) in real world applications.

UNIT-I

16 Hours

Remote sensing and its Principles: Physics of remote sensing, EM spectrum, Blackbody concept, atmospheric windows, spectral response of common earth features.
Platforms & Sensors: Ground based, Air borne and Space borne platforms, Active and Passive Sensors, Photographic sensors, scanners, radiometers, RADAR and thermal infrared, hyper spectral remote sensing, Indian satellites and sensors: capabilities, data products
Photogrammetry: Basic principles of Aerial photography and Photogrammetry, Flight procedures, Aerial Photo Interpretation and Analysis techniques.
Satellite Image Interpretation and Analysis techniques: Visual & Digital Image interpretation, Interpretation elements, False Colour Composites (FCC).

UNIT-II

15 Hours

Digital Image Processing and Analysis: Digital image formats, pre-processing and processing (DIP), image restoration/enhancement procedures, information extraction, pattern recognition concepts, post processing procedures.
Geographic Information System -concept and spatial models: Fundamentals of GIS, spatial and non-spatial data, vector and raster GIS, GIS Hardware and software, georeferencing, digitization, thematic maps, Overlay Analysis, Operation of GIS, Co-ordinate systems and map projections, Map scale, data display and cartography.

UNIT-III

09 Hours

Geoinformatics and Virtual GIS: Modern Surveying and Geoinformatics, GPS & GNSS, GIS Functionality: Introduction, data acquisition, preliminary data processing, data storage and retrieval, spatial search and analysis, graphics and interaction, Virtual GIS and Real world applications.

Course Outcomes: At the end of the course student will be able to

1.	Define and explain the principles of Remote Sensing and list various types of platforms, sensors & resolutions in RS with a special reference to Indian satellites and data products.
2.	Explain Photogrammetry, its basic principles, elements of photo interpretation, Visual & Digital Image interpretation techniques

3.	Explain different stages involved in Digital Image Processing, various image enhancement techniques, list and classify the digital image formats and the extracted information for various purposes.
4.	Explain and Appraise GIS - its components, data structures, process and operation, Map and its projections, components, preparation and Overlays.
5.	Explain the GIS functionality and appraise the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) and Virtual GIS in real world applications.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CV2504-1.1	2	2	-	-	-	2	-	-	-	-	-	-
CV2504-1.2	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.3	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.4	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.5	2	2	-	-	-	2	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anji Reddy, M, "Text Book of Remote Sensing and Geographical Information Systems", Fourth Edition, BS Publication, Hyderabad, 2012.
2.	Bhatta, Basudeva, "Remote Sensing and GIS", 2nd edition, Oxford University Press, N. Delhi, 2011.
3.	Lillesand, T.M., Kiefer, R.W and Chipman, J. W., "Remote sensing and Image Interpretations", 7th edition, John Wiley and sons, New Delhi, 2015.

REFERENCE BOOKS:

1.	Anji Reddy, M. and Hari Shankar, Y., "Digital Image Processing", BS Pub., Hyd, 2006.
2.	Bernhardsen, Tor, "Geographic Information Systems", 3rd Ed., Wiley India, Delhi, 2002.
3.	Canada Centre for Remote Sensing, Fundamentals of Remote sensing-Tutorial, 2011.
4.	Chang, Kang-tsung, "Introduction to Geographic Information Systems", 4th Ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
5.	Korte, George B., "The GIS Book", Onword Press, Thomson Learning Inc., USA, 2001.
6.	Kumar, S., "Basics of Remote sensing and GIS", Laxmi Publications (P) Ltd., Delhi, 2008.
7.	Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., "Geographic Information Systems and Science", John Wiley & Sons Ltd., ESRI Press, 2004.
8.	Sabins, F. L., "Remote Sensing: Principles and Interpretation" 3rd edn. WH Freeman and Company, New York, 1997.

E Books / MOOCs/ NPTEL

1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

CORROSION SCIENCE

Course Code:	**CY2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CY1001-1**		

Teaching Department: Chemistry

Course Objectives:

1.	To provide fundamental understanding aspects of electrochemistry and material science related to corrosion. To understand the types of corrosion attacking on the metal and its preventions.
2.	To impart knowledge on corrosion science and its applications to the engineering materials.
3.	To identify practice for the prevention and remediation of the corrosion. To provide methodologies for measuring the corrosion performance of materials.

UNIT-I

Fundamentals of Corrosion	**09 Hours**
Definition, cost of corrosion, Corrosion Damage and consequences, Classification of corrosion, Electrochemical Aspects of corrosion, Electrochemical reactions, Different Environmental aspects, polarization and passivity, Corrosion Rate Expression, Determination. Standard electrode potential, EMF and Galvanic series, Potential-pH (Roubaix Diagram).	
Forms of Corrosion	**08 Hours**
Galvanic corrosion, Crevices corrosion, Filiform corrosion, Pitting corrosion, Uniform corrosion and Atmospheric corrosion, Inter granular corrosion, Selective leaching, Erosion corrosion, Cavitation damage, Stress corrosion , Impingement attack, Inlet tube corrosion, Corrosion fatigue, Hydrogen blistering, Hydrogen embrittlement.	

UNIT-II

Corrosion at Elevated Temperature	**08 Hours**
High temperature materials, Metal oxides, Pilling bed worth rule, oxide defect structure, Hot corrosion, Corrosion of mineral acids-corrosion of steel, stainless steel, Cu and Al.	
Corrosion Testing	**07 Hours**
Weight loss method, Tafel extrapolation test, linear polarization test and AC impedance method.	

UNIT-III

Corrosion Prevention Methods	**08 Hours**
Materials Selections, Design, Change of the environments: Atmospheric corrosion, Control of atmospheric corrosion, Changing medium, Inhibitors, Cathodic and Anodic protection, Protective coatings.	

Course Outcomes: At the end of the course student will be able to

1.	Explain the fundamentals of difference in electrode potential across an interface in particular a metal/ electrolyte and the relationship between rates of electrochemical reactions and the potential drop across interfaces.
2.	Analyze the causes and mechanisms of various types of corrosion including uniform, galvanic, crevice, pitting, inter granular and various modes of environmentally cracking. Acquire knowledge of influence of a materials composition, the effect of an electrolytes composition on the corrosion of metals and microstructure on its corrosion performance.
3.	Identify the materials that will exhibit adequate corrosion resistance in a particular environment and remedial action that will reduce corrosion to a acceptable level. Explain the concepts of different measuring techniques of corrosion.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CY2501-1.1	3	3	3	-	-	1	1	-	-	-	-	-
CY2501-1.2	3	3	3	-	-	1	1	-	-	-	-	-
CY2501-1.3	3	3	3	-	-	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Mars G Fontana, "Corrosion Engineering", 3rd Edition, Tata Mcgraw-Hill Edition.

REFERENCE BOOKS:

1	Chamberlian and K. Trethway, "Corrosion", Longman scientific and technical, John Wiley and Sons.

NATURAL PRODUCTS CHEMISTRY

Course Code:	**CY2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CY1001-1**		

Teaching Department: Chemistry

Course Objectives:

1.	Identify the structure of terpenoids and their biosynthesis. Elucidate the structure of β-carotene, haemoglobin and chlorophyll.
2.	Understand the chemistry underlying steroids and sex hormones. Get introduced to the different types of prostaglandins as well as theory and chemistry behind natural dyes.
3.	Gain knowledge on general methods of structural determination of some of the important alkaloids.

UNIT-I

Terpenoids & Carotenoids — **08 Hours**

Introduction and classification, isoprene rules, general methods of determination of structure of terpenoids. Structure elucidation of the following terpenoids-geraniol, α-pinine, camphene and farnesol. Biosynthesis of terpenoids.
Introduction and classification of carotenes. Structural elucidation of β-carotene.

Porphyrins — **07 Hours**

Introduction to porphyrins, structure and degradation products of haemoglobin and chlorophyll.

UNIT-II

Steroids — **08 Hours**

Introduction, Dile's hydrogenation. Chemistry of cholesterol, Blanc's rule, Barbier-Wielman degradation, Oppenuer oxidation. Constitution of bile acids.
Sex hormones: Chemistry of oestrone, progesterone, androsterone and testosterone.

Prostaglandins & Natural Dyes — **08 Hours**

Introduction, nomenclature, classification, and biological role of prostagladins. Structure elucidation of PGE_1, Biosynthesis of PGE_2 and $PGF_{2\alpha}$.
Introduction, Witt's theory of colour, methods of dyeing, chemical constitution of alizarin.

UNIT-III

Alkaloids — **09 Hours**

Definition, Classification and isolation of alkaloids. General methods of structural determination of alkaloids. Detailed study of structure elucidation of the following alkaloids- papaverine, cinchonine and nicotine.

Course Outcomes: At the end of the course student will be able to

1	Elucidate the structure of terpenoids like geraniol, a-pinine, camphene and farnesol. Explain the structural chemistry of carotenoids and porphyrins.
2	State the basic reactions governing steroids and sex hormones. Explain the biological role and structure of prostaglandins and state the methods employed for dyeing.
3	Apply the general methods of structural determination to elucidate the structure of alkaloids like papaverine, cinchonine and nicotine.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CY2502-1.1	3	3	-	-	-	1	1	-	-	-	-	-

CY2502-1.2	3	3	-	-	-	1	1	-	-	-	-	-
CY2502-1.3	3	3	-	-	-	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Agarwal, "Organic Chemistry of Natural Products", Vol.-I & Vol.-II, O.P. Goel Publishing House, 2014.

REFERENCE BOOKS:

1.	K. Nakanishi, T. Goso, S. Ito, S. Natori and S. Nozoe, "Natural Products Chemistry", Vol. I & II, Academic Press, Ny, 1974.
2.	Gurudeep R. Chatwal, "Organic Chemistry of Natural Products", Vol. I & II, Himalaya Publishing House, 2013.
3.	G.A. Swal, "An Introduction to Alkaloids", Backwell Scientific Publications, 1967.
4.	Hand book of naturally occurring Compounds, Vol. II, terpenes, T.K. Davon, A.I. Scott, Academic Press, Ny, 1974.

ARTIFICIAL NEURAL NETWORK SYSTEMS

Course Code:	**EC1501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To learn basic building blocks of ANNs and its terminology
2.	To understand the working of McCulloch-Pitts Neuron and different types of learning rules
3.	To understand decision regions, discriminant functions and training concept
4.	To understand the working of perceptron as classifier
5.	To understand the mathematics behind different types of single layer feedback networks

UNIT-I

Introduction to Artificial Neural networks — **16 Hours**

Introduction, Basic building blocks: network architecture, setting the weights, activation functions, ANN terminologies: weights, activation functions, bias, threshold, McCulloch-Pitts Neuron Model, Learning Rules

UNIT-II

Single Layer Perceptron Classifiers — **15 Hours**

Classification Model, Features, and Decision Regions, Discriminant Functions, Linear Machine and Minimum Distance Classification, Nonparametric Training Concept, Training and Classification Using the Discrete Perceptron: Algorithm and Example, Single-Layer Continuous Perceptron Networks for Linearly Separable Classifications, Multicategory Single-Layer Perceptron Networks

UNIT-III

Single-Layer Feedback Networks — **09 Hours**

Basic Concepts of Dynamical Systems, Mathematical Foundations of Discrete-Time Hopfield Networks, Mathematical Foundations of Gradient-Type Hopfield Networks. Transient Response of Continuous-Time Networks, Relaxation Modeling in Single-Layer Feedback Networks

Course Outcomes: At the end of the course student will be able to

1.	Describe the building blocks of artificial neural and terminologies
2.	Describe the working of neural network and learning rules
3.	Describe training of Single layer perceptron and classification using it.
4.	Explain use of Single layer perceptron for linearly separable and multicategory problems
5.	Explain the mathematics behind different single-layer feedback networks

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC1501-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.2	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.3	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.4	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.5	3	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Education, 2006
2.	Jacek M. Zurada "Introduction to Artificial Neural Systems", 1st Edition, St. Paul West Publishers-USA, 1992.
3.	Michael A Neilsen, "Neural Networks and Deep Learning", Determination Press, 2015

INTRODUCTION TO MATLAB PROGRAMMING: A HANDS-ON APPROACH

Course Code:	**EC1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**2:0:2:0**	**Credits**	**03**
Total Teaching Hours	**27+0+26+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electronics & Communication Engineering
Offered to Civil & BT

Course Objectives:

1.	To demonstrate basic understanding of MATLAB programming
2.	To use and write functions
3.	To use MATLAB programming for image processing

Unit-I	**27 Hours**

Introduction to MATLAB: Starting MATLAB and familiarization with its user interface, syntax and semantics, ways in which MATLAB provides help, create plots in MATLAB.
Matrices and Operators: defining matrices, manipulation of matrices, extract parts of them and combine them to form new matrices, use of operators to add, subtract, multiply, and divide matrices, and we will learn that there are several different types of multiplication and division.
Functions: creating reusable functions, how the environment inside a function is separated from the outside via a well-defined interface through which it communicates with that outside world, define a function to allow input to it when it initiates its execution.
Programmer’s Toolbox: polymorphism and how MATLAB exploits it to change a function's behavior on the basis of the number and type of its inputs, random number generator, how to get input from the keyboard, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger.
Selection Statement and Loops: how to use the if-statement, how to use relational operators and logical operators, how to write polymorphic functions and how to make functions resistant to error, the for-loop and the while-loop, how the break-statement works, nested loops, logical indexing and implicit loops.
Data Types: character arrays and how the characters in them are encoded as numbers, string and datetime datatype, how to produce heterogeneous collections of data via structs and cells.
File Input/Output: reading and writing files, how to create, read from, and write into MAT-files, Excel files, text files, and binary files, how to navigate among folders with MATLAB commands.
Image Processing using MATLAB: pre-processing – conversion of color image to gray scale image, decomposition of color images to single color component image, histogram of image, thresholding

List of Experiments

1	Starting MATLAB and familiarization with its user interface, syntax and semantics, ways in which MATLAB provides help, create plots in MATLAB.
2	Defining matrices, manipulation of matrices, extract parts of them and combine them to form new matrices, use of operators to add, subtract, multiply, and divide matrices, and we will learn that there are several different types of multiplication and division.
3	creating reusable functions, how the environment inside a function is separated from the outside via a well-defined interface through which it communicates with that outside world, define a function to allow input to it when it initiates its execution.
4	Polymorphism and how MATLAB exploits it to change a function's behavior on the basis of the number and type of its inputs, random number generator, how to get input from the keyboard, how to print to the Command Window

5	How to plot graphs in a Figure window, how to find programming errors with the help of the debugger, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger.
6	How to use the if-statement, how to use relational operators and logical operators, how to write polymorphic functions and how to make functions resistant to error.
7	The for-loop and the while-loop, how the break-statement works, nested loops, logical indexing and implicit loops.
8	Character arrays and how the characters in them are encoded as numbers, string and datetime datatype, how to produce heterogeneous collections of data via structs and cells.
9	Reading and writing files, how to create, read from, and write into MAT-files, Excel files, text files, and binary files, how to navigate among folders with MATLAB commands.
10	Reading an image, saving, basic manipulation of images, arithmetic operations
11	Pre-processing – conversion of color image to gray scale image, decomposition of color images to single color component image.
12	Histogram processing.
13	Thresholding operation.

Course Outcomes: At the end of the course student will be able to

1.	Use matrices and operators in MATLAB programming
2.	Use and write functions; use MATLAB toolbox
3.	Use toolbox and selection statement in MATLAB programming
4.	Write MATLAB programs using loops and summarize data types
5.	Summarize file input/output methods using MATLAB commands and apply pre-processing and thresholding operations on images

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC1502-1.1	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.2	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.3	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.4	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.5	1	-	-	-	3	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Stormy Attaway, “Matlab: A Practical Introduction to Programming and Problem Solving”, Second Edition, Butterworth-Heinemann, 2011
2.	Fitzpatrick and Ledeczi, “Computer Programming with MATLAB”, eBook, 2013
3.	Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, Digital Image Processing using MATLAB, first edition, Dorling Kindersley Pvt Ltd, 2006.

REFERENCE BOOKS:

1.	Duane C. Hanselman, Bruce L. Littlefield, “Mastering MATLAB” , first edition, Pearson, 2011

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/103/106/103106118/
2.	https://www.coursera.org/learn/matlab

ROBOTICS

Course Code:	**EC1503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand Anatomy of a robot.
2.	Analyse the robot motion using translation and rotational matrix.
3.	Discuss Robot trajectory planning and robot control.
4.	Categorise the various sensors used in robotics
5.	Understand the robot programming.

UNIT-I

Introduction	**16 Hours**

Definition, anatomy of robot, classification configurations, robot links and joints, robot specifications, resolution accuracy and repeatability, simple numerical problems, robot drive systems, hydraulic, pneumatic and electric drive systems, wrist and its motions, end effectors, types of end effectors, mechanical & Non-mechanical grippers, methods of constraining parts in grippers.

Motion analysis

Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis.

UNIT-II

Control and trajectory planning	**15 Hours**

Trajectory planning, definition, steps in trajectory planning, joint space techniques, use of a p-degree polynomial as interpolation function, cubic polynomial trajectories, linear function with parabolic blends, joint space verses, simple numerical problems on joint space trajectory planning.

Sensors

Classification, Types- Contact & Non-Contact sensors.

Machine Vision

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual surveying and navigation.

UNIT-III

Programming	**09 Hours**

Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, robot programming languages, examples

Course Outcomes: At the end of the course student will be able to

1.	Explain the working principle, various performance parameters of robots and identify the types of robots employed in industry.
2.	Discuss the concept of direct and inverse kinematics. Determine the position and orientation of End-Effector subjected to transformations. Demonstrate the applications of Denavit-Hartenberg (DH) method for different robot configurations.
3.	Determine the technique of trajectory planning, control schemes for robot joints and understand the types of the sensors used in robotics.
4.	Apply engineering knowledge in robot visual surveying and navigation.

5.	Analyze and formulate different types of robot cell layouts and use modern tools to write robot programs for different tasks.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
EC1503-1.1	3	2	2	1	-	-	-	-	-	-	-	1
EC1503-1.2	3	3	2	2	-	-	-	-	3	3	-	1
EC1503-1.3	3	2	2	2	-	-	-	-	3	3	-	1
EC1503-1.4	3	2	2	1	-	-	-	-	-	-	-	1
EC1503-1.5	3	3	3	2	2	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. R. K. Mittal and I. J. Nagrath, “Robotics and Control”, Tata-McGraw-Hill Publications, 2007.
2. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial Robotics”, McGraw-Hill Publications, International Edition, 2008

REFERENCE BOOKS:

1. Fu K. S., Gonzelez R. C., Lee C. S. G., "Robotics: Control, Sensing, Vision, Intelligence," , McGraw Hill Book Co., International edition, 2008.
2. Yorem Koren, "Robotics for Engineers", McGraw-Hill Publication, International edition, 1987.
3. Craig, J. J., "Introduction to Robotics: Mechanics and Control", 3rd Edition, Pearson PrenticeHall Publications, 2005.
4. Schilling R. J., "Fundamentals of Robotics, Analysis and Control", Prentice-Hall Publications, Eastern Economy edition, 2007.
5. AppuKuttan K. K., "Robotics", I.K. International Publications, First Edition, 2007.
6. James G. Keramas, "Robot Technology Fundamentals", Cengage Learning, 1999.
7. Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, "Introduction to Unmanned Aircraft Systems", CRC Press, 2012.
8. Ghosh, "Control in Robotics and Automation", Allied Publishers.
9. Deb, "Robotics Technology", Wiley India.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/112105249

CONSUMER ELECTRONICS

Course Code:	**EC2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To provide basic knowledge on sound and transducers
2.	To provide basic knowledge on different display units and camera
3.	To understand the recording process and storage mechanism
4.	To provide basic knowledge on communication and broadcasting
5.	To understand the working of various electronic gadgets

UNIT-I

Sound & Vision	**15 Hours**

Sound: Definition and properties of sound, Transducers: Micro Phone – characteristics and types, and Loud Speakers – characteristics and types, Enclosures and baffles, mono-stereo, audio amplifiers-characteristics, Synthesizers.

Vision: Displays-LED, LCD, PLASMA, Camera: basic principle, CCTV Camera.

UNIT-II

Recording, Playback, Communication & Broadcasting Systems — **15 Hours**

Recording and Playback: Audio recording methods-magnetic recording, optical recording, digital recording, erasing methods, optical discs- recording and playback, Film projector, Theatre Sound, HiFi system.
Communications And Broadcasting: Modulation: AM, FM PCM, Radio transmitters, Radio receivers - Tuned radio frequency receiver and Superheterodyne receiver. Fiber optics, Radio and TV broadcasting. Cellular communication: digital cellular phone, establishing a call.

UNIT-III

Other Electronic Systems — **10 Hours**

Fax machine, Xerox machine, electronic Calculator, Microwave ovens, Washing Machines, A/C and refrigeration, ATM, Auto Electronics, Industrial Electronics and Robotics, Electronics in health / Medicine.

Course Outcomes: At the end of the course student will be able to

1.	Recall basics of sound and transducers.
2.	Understand the working principles of display units and CCTV camera.
3.	Explain basic working of Recording, storage devices
4.	Explain basics of communication and broadcasting
5.	Recall basic working of commonly used electronic gadgets

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC2501-1.1	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.2	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.3	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.4	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.5	1	-	-	-	-	1	-	-	-	-	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Anand, “Consumer Electronics”, Khanna publications, 2011.
2. Bali S. P., “Consumer Electronics”, Pearson Education, 2005.

REFERENCE BOOK:

1. Gulati R. R. "Modern Television Engineering", Wiley Eastern.

PCB DESIGN AND FABRICATION

Course Code	**EC2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**1:0:4:0**	**Credits**	**03**
Total Teaching Hours	**15+0+52+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2.	To expose students to complete PCB Design & manufacturing process

Unit-I

Circuit Schematic — **05 Hours**

Introduction to Kicad schematic design tool, features, node connections, labeling, creating new component.

Unit-II

PCB Layout: — **05 Hours**

Introduction to Kicad layout editor, features, layer selections, manual and auto routing in Kicad, verification of footprint, creating footprint for a given component.

Unit-III

PCB Fabrication — **05 Hours**

Generating and verifying the PCB Gerber file, preparing artwork for a single side PCB fabrication, preparing PCB artwork for double side PCB, Etching process, tin plating, legend printing, green masking and through hole plating

List of Experiments

1	Exploring the Kicad Schematic and layout tool
2	Developing a schematic circuit for microphone preamplifier
3	Designing a single side PCB layout for microphone preamplifier
4	Developing a schematic circuit for a microcontroller development board
5	Designing a double side PCB layout for a microcontroller development board
6	Choosing a new sensor/display module and building a schematic circuit for the user level application
7	Building a layout using single or double side PCB for the sensor/display module
8	Preparing the film for the bottom copper, solder mask and top silk (legend) to fabricate a single side PCB using chemical process
9	Preparing the film for the top copper, bottom copper, top solder mask, bottom solder mask and legend to fabricate double side PCB using chemical process
10	PCB routing, etching, cutting and drilling using CNC machine

Course Outcomes: At the end of the course student will be able to

1.	Draw schematic circuit and create PCB layout for single or multilayer PCB
2.	Fabricate single and double-layer PCB

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
EC2502-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EC2502-1.2	3	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	Peter Dalmaris, "Kicad Like a Pro", Tech Exploration.
REFERENCE BOOKS:	
1.	Peter Dalmaris, "Kicad Like a Pro", Tech Exploration.
2.	David L. Jones, "PCB Design Tutorials", Alternate zone, 2004.
E Books / MOOCs/ NPTEL	
1.	www.alternatezone.com

SPACE TECHNOLOGY AND APPLICATIONS

Course Code:	**EC2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the general laws governing satellite orbits and its parameters.
2.	Discuss effect of space environment on satellite signal propagation.
3.	Illustrate various segments employed in satellite and ground station.
4.	Calculate the uplink / downlink subsystem characteristics.
5.	know the effects on the EM waves in propagation through space.
6.	Explain the satellite launch in the space and their applications in remote sensing.
7.	Discuss the different communication systems used for satellite access.
8.	Summarise Advanced space systems for mobile communication, VSAT, GPS.

UNIT-I

Satellite Technology	**15 Hours**

Satellite communications: Introduction, Kepler's laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits.
Space environment: Earth's Atmosphere, Ionosphere and Meteorological effects on space systems, propagation of signal, Transmission losses in space environment.
Satellite Technology: Space segment, Ground segment, Quality and Reliability, Satellite Communication systems.

UNIT-II

Space Applications	**15 Hours**

Launch Vehicles: Working, stages, Fuel, payload protection, Navigation, guidance and control, Reliability, launching into outer space and launch bases. Types of launch vehicles.
Space Applications: Digital DBS TV, DBS-TV System Design, Master Control Station and Uplink Antennas. Introduction, Radio and Satellite Navigation,
Remote Sensing: Introduction to Remote Sensing, Concepts and Applications of satellite Remote sensing.

UNIT-III

Advanced Space Systems	**10 Hours**

Satellite Access: Introduction, Single Access, Pre-assigned FDMA, Demand-Assigned FDMA, Spade system.
Advanced space systems: Satellite mobile services, VSAT, Radarsat, orbital communication**.** Global Positioning Satellite System (GPS).

Course Outcomes: At the end of the course student will be able to

1.	Discuss the fundamental principles of Satellite communication systems.
2.	Understand the Propagation impairments of satellite link.
3.	Explain various segments employed in satellite and ground station.
4.	Discuss the satellite launch mechanism and roll of those satellite in remote sensing.
5.	Understand the different communication systems used for satellite access and list the recent satellites that have been launched for mobile communication, GPS.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
EC2503-1.1	3	2	2	-	1	-	-	-	-	-	-	-
EC2503-1.2	-	3	-	-	2	1	-	-	-	-	-	-
EC2503-1.3	3	-	-	1	-	1	1	-	-	-	-	-
EC2503-1.4	-	-	-	-	-	1	3	-	-	-	-	-
EC2503-1.5	-	-	-	-	-	3	3	2	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Dennis Roddy, “Satellite Communications”, McGraw Hill ,1996.
2. Timothy Pratt, “Satellite Communications”, Wiley India Ltd , 2006.
3. K Ramamurthy, “Rocket Propulsion”, McMillan Publishers India Ltd, 2010.

REFERENCE BOOKS:

1. George Joseph, “Fundamentals of Remote Sensing”, Universities press, India 2003.
2. B C Pande, “Remote sensing and Applications”, VIVA Books pvt ltd, 2009.
3. Meynart Roland, “Sensors systems and next generation satellites”, SPIE Publication.
4. Thyagarajan , “Space Environment”, ISRO Hand Book Publication.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/101106046

BATTERY MANAGEMENT SYSTEM

Course Code:	**EE2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1	To familiarize various concepts of BMS
2	To understand functional blocks of BMS
3	To study design steps of BMS
4	To introduce hardware implementation of BMS

UNIT-I

Battery System — **08 Hours**

Introduction, Cells, Batteries, and Packs, Resistance, Li-Ion Cells, Formats, Chemistry, Safety, Safe Operating Area, Efficiency, Aging, Modeling, Unequal Voltages in Series Strings, Li-Ion BMSs, BMS Definition, Li-Ion BMS Functions, Custom Versus Off-the-Shelf, Li-Ion Batteries, SOC, DOD, and Capacity, Balance and Balancing, SOH

BMS Options — **07 Hours**

Functionality, CCCV Chargers, Regulators, Meters, Monitors, Balancers, Protectors, Functionality Comparison, Technology, Simple (Analog), Sophisticated (Digital), Technology Comparison, Topology, Centralized, Modular Master-Slave, Distributed, Topology Comparison

UNIT-II

BMS Functions — **07 Hours**

Measurement, Voltage, Temperature, Current, Management, Protection, Thermal Management, Balancing, Redistribution, Distributed Charging, Evaluation, State of Charge and Depth of Discharge, Capacity, Resistance, State of Health (SOH), External Communications, Dedicated Analog Wire, Dedicated Digital Wire, Data Link, Logging and Telemetry, Off-the-Shelf BMSs, Cell Manufacturers' BMSs, Comparison

Custom BMS Design — **08 Hours**

Using BMS ASICs , BMS ASIC Comparison, Analog BMS Design, Analog Regulator, Analog Monitor, Analog Balancer, Analog Protector, Ready-Made, Digital BMS Designs, ATMEL's BMS Processor, Elithion's BMS Chip Set, National Semiconductors' Complete BMS, Peter Perkin's Open Source BMS, Texas Instruments' bq29330/bq20z90, Texas Instruments' bq78PL114/bq76PL102, Custom Digital BMS Design, Voltage and Temperature Measurement, Current Measurement, Evaluation, Communications, Optimization, Switching, Logging, Cell Interface, Non-distributed, Distributed, Distributed Charging

UNIT-III

Deploying a BMS — **10 Hours**

Installing, Battery Pack Design, BMS Connections to Pack, BMS Connections to System, Configuring, Cell Configuration, Pack Configuration, System Configuration, Testing, Troubleshooting, Grounding, Shielding, Filtering, Wire Routing

Course Outcomes: At the end of the course student will be able to

1	Identify process to implement BMS
2	Describe various communication protocol involved in BMS
3	Illustrate functionality of BMS
4	Apply concepts of BMS using application specific IC

5	Analyse the hardware implementation aspects of BMS

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2501-1.1	1	3	-	-	-	-	-	-	-	-	-	-
EE2501-1.2	1	3	-	-	-	-	-	-	-	-	-	-
EE2501-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2501-1.4	1	2	2	3	-	-	-	-	-	-	-	-
EE2501-1.5	1	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs", ARTECH HOUSE 2010.

REFERENCE BOOKS:

1	Rui Xiong, "Battery Management Algorithm for Electric Vehicles", Springer 2019.
2	Nicolae Tudoroiu, "Battery Management Systems of Electric and Hybrid Electric Vehicles", MDPI 2021

BIOMEDICAL INSTRUMENTATION

Course Code:	**EE2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	The course is designed to give the basic concepts of Instrumentation involved in medical field and human physiology.
2.	To introduce an fundamental of transducers as applicable to physiology
3.	To explore the human body parameter measurements setups
4.	To make the students understand the basic concepts of forensic techniques.
5.	To give basic ideas about Electrophysiological measurements, medical imaging

UNIT-I

Physiology and transducers	**08 Hours**

Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature measurements, Fiber optic sensors.

Electro – Physiological measurements	**09 Hours**

Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: shock hazards, leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT-II

Non-electrical parameter measurements	**08 Hours**

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analyzers : pH of blood, measurement of blood pCO2, pO2, finger-tip oximeter, ESR, GSR measurements

Medical Imaging	**07 Hours**

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, fMRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems and patient monitoring

UNIT-III

Assisting and therapeutic equipments:	**08 Hours**

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audio meters, Dialyzers, Lithotripsy

Course Outcomes: At the end of the course student will be able to

1	Understand the physiology of biomedical system
2	Measure biomedical and physiological information
3	Discuss the application of Electronics in diagnostics and therapeutic area.
4	Analyze the images and do a prediction using image processing.
5	Understand the different equipment’s used for various measurements of physiology

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
EE2502-1.1	3	3	-	2	1	1	-	-	-	-	-	-
EE2502-1.2	2	2	2	2	-	-	-	-	-	-	-	-
EE2502-1.3	3	2	2	1	2	1	-	-	-	-	-	-
EE2502-1.4	2	3	-	-	1	-	-	-	-	-	1	-
EE2502-1.5	3	3	-	-	2	-	-	-	-	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", II edition, Pearson Education, 2002.
2.	R. S. Khandpur, "Handbook of Bio-Medical instrumentation", Tata McGraw Hill Publishing CoLtd., 2003.
3.	J. Webster, "Medical Instrumentation", John Wiley & Sons, 1995.
4.	L. A. Geddes and L. E. Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.
5.	David. Cooney and Michel Deckker, "Bio- Medical Engineering Principles", INC.

REFERENCE BOOKS:

1	David Cooney, "Bio-Medical Engineering Principles", 2015, 1st Edition, Marcel Deckker Pub Co., New York.

ELECTRIC VEHICLE TECHNOLOGY

Course Code:	**EE2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1	To Understand the fundamental laws and vehicle mechanics.
2	To Understand working of Electric Vehicles and recent trends.
3	Ability to analyze different power converter topology used for electric vehicle application
4	Ability to develop the electric propulsion unit and its control for application of electric vehicles

UNIT-I

Vehicle Mechanics	**07 Hours**

Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Nonconstant FTR, General Acceleration, Propulsion System Design..

Electric and Hybrid Electric Vehicles	**07 Hours**

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive train).

UNIT-II

Energy storage for EV and HEV	**08 Hours**

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.

Electric Propulsion	**08 Hours**

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT-III

Design of Electric and Hybrid Electric Vehicles	**10 Hours**

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.

Course Outcomes: At the end of the course student will be able to

1	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design
2	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
3	Model batteries, Fuel cells, PEMFC and super capacitors.

4	Analyze DC and AC drive topologies used for electric vehicle application.
5	Develop the electric propulsion unit and its control for application of electric vehicles.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2503-1.1	2	3	-	-	-	-	-	-	-	-	-	-
EE2503-1.2	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.4	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.5	1	2	2	-	-	-	-	-	-	-	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
2	M. Ehsani, Y. Gao, S.Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2005.

REFERENCE BOOKS:

1	Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
2	C.C. Chan and K.T. Chau, "Electric Vehicle Technology", OXFORD University, 2001
3	Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles Principles And Applications with Practical Perspectives", Wiley Publication, 2001

E Books / MOOCs/ NPTEL

1.	Introduction to Mechanics | Coursera
2.	Electric Vehicles - Part 1 - Course (nptel.ac.in)
3.	NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
4.	Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
5.	Electric Cars: Technology | My MOOC (my-mooc.com)

FUNDAMENTALS OF PLC AND ITS APPLICATIONS

Course Code:	**EE2504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	To understand main parts and their functions, basic sequence of operation of PLC.
2.	To study the different programming languages and fundamental wiring diagrams.
3.	To explain the functions of PLC counter instructions, applying combinations of counters and timers to control systems.
4.	To explain the basic operation of PLC closed-loop control system, various forms of mechanical sequencers and their operations
5.	To discuss the operation of various processes, structures of control systems and the method of communication between different industrial processes

UNIT-I

Programmable Logic Controllers	**02 Hours**
Introduction, Parts of a PLC, Principles of Operation, PLC Size and Application.	
PLC Hardware Components	**05Hours**
The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Human Machine Interface (HMIs).	
Basic Programming Language	**05Hours**
Ladder diagrams, Ladder conventions, Logic functions with timing diagram, latching, multiple outputs, entering programs, Functional blocks, Program examples, instruction list, branch codes, programming examples, Sequential functions charts, branching and convergence, actions, Structured Text, conditional and iteration statements	
Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs	**03Hours**
Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description.	

UNIT-II

Programming Timers	**02 Hours**
Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)	
Programming Counters	**04 Hours**
Counter Instructions, Up-Counter, Down-Counter, Cascading Counters, Incremental Encoder-Counter Applications, Combining Counter and Timer Functions.	
Program Control Instructions	**05 Hours**
Master Control Reset Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt, Fault Routine, Temporary End Instruction, Suspend Instruction.	
Data Manipulation Instructions	**02 Hours**
Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs, Numerical Data I/O Interfaces, Closed-Loop Control.	

Math Instructions	**02 Hours**
Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction, Division Instruction, Other Word-Level Math Instructions, File Arithmetic Operations	
UNIT-III	
Sequencer and Shift Register Instructions	**05 Hours**
Mechanical Sequencers, Sequencer Instructions, Sequencer Programs, Bit Shift Registers, Word Shift Operations.	
Process Control, Network Systems, and SCADA	**05 Hours**
Types of Processes, Structure of Control Systems, On/Off Control, PID Control, Motion Control, Data Communications, Supervisory Control and Data Acquisition (SCADA).	

Course Outcomes: At the end of the course student will be able to

1.	Identify main parts, functions of PLC and describe basic circuitry for I/O modules to select PLC for desired application
2.	Apply suitable logic using various programming languages to achieve specific control mechanism for a given application
3.	Identify timer/counter resources of a PLC to design control logic for interfaced device.
4.	Interpret data manipulation and math instructions as they apply to a PLC program
5.	Develop programs that use shift registers and explain functions of control elements of a closed loop control system

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2504-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EE2504-1.2	1	3	-	-	-	-	-	-	-	-	-	-
EE2504-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2504-1.4	1	2	3	-	-	-	-	-	-	-	-	-
EE2504-1.5	1	2	3	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Frank Petruzella, "Programming Logic Controllers", Fifth Edition.
2.	W Bolton, "Programmable Logic controllers", 6th edition, Elsevier- newness, 2015.

REFERENCE BOOKS:

1.	John W Webb, Ronald A Reis, "Programmable logic controllers - principles and applications", 5th edition, 2nd impression, Pearson education, 2009
2.	L. A Bryan, E. A Bryan, "Programmable Controller Theory and Implementations", 2nd edition, 2003
3.	S. P. Sukhumi, J. K. Nayak, “Solar Energy: Principles Collection and Storage”, 3rd edition, McGraw-Hill Education (India) , 2009.

E Books / MOOCs/ NPTEL

1.	https://library.automationdirect.com/category/product/programmable-control/
2.	https://www.coursera.org/lecture/intelligent-machining/programmable-logic-controllers-plc-fGz3r
3.	https://www.udemy.com/course/plc-programming-from-scratch/

MOTORS AND MOTOR CONTROL CIRCUITS

Course Code:	**EE2505-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	Study architecture of induction motor and synchronous motor
2.	Understanding control of AC motor
3.	Study principle of operation of different dc motors
4.	Understand the different types of control techniques
5.	Study different sensors and their role in control of a motor

UNIT-I

AC Motor Designs — **08 Hours**

Introduction, Three phase AC motor architecture, Torque speed curve, wound rotor, Synchronous motors

Single phase AC motors, split phase motor, capacitor start and shaded pole motors, Universal and gear motors, AC Motor Specifications, Specifying an AC motor for an application.

AC Motor Control: — **07 Hours**

AC motor Enclosures, AC motor control components, Manual motor starting systems, Direct On Line Starter, semi-automatic star delta starter, fully automatic star delta starter, control circuit for sequence operation of two motors

UNIT-II

DC Motors — **07 Hours**

DC motor principle of operation, Brushed DC motors, shunt, series and compound wound motors, Brushless DC motors, driving a brushless DC motor, Commutation, Specifying a DC motor

DC Motor Control and Stepper Motors — **08 Hours**

Stepper motor principles of operation, Illustrative example of a stepper motor drive, stepper motor specification and operation, commercial stepper motor drive chips and packages, Direction Controller- H Bridge, Speed Controller: Pulse Width Modulation (PWM), Armature Controller: Variable resistance, DC vs.AC motors

UNIT-III

Sensors — **10 Hours**

Unipolar Hall Effect Switches, Omnipolar Hall Effect Switches, Latched Hall Effect Switches, Current Sensors: Shunt resistor, Current-sensing transformer, Hall effect current sensor, Speed/position sensors: Quadrature encoder, Hall effect tachometer, Back EMF/Sensorless control method, BLDC motor control with Hall sensor, Block diagram approach of BLDC Fan and Motor Control

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate an understanding of the general principles of AC Motor.
2.	Understand the basic principles of AC motor controls which includes starters, contactors, and control relays
3.	Demonstrate an understanding of the general principles of DC Motor.

4.	Understand the basic principles of DC motor controls which includes starters, contactors, and control relays
5.	Set up sensors in order to give feedback to a control circuit

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2505-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EE2505-1.2	2	3	3	-	-	2	-	-	-	-	-	-
EE2505-1.3	3	-	-	-	-	-	-	-	-	-	-	-
EE2505-1.4	2	3	3	-	-	2	-	-	-	-	-	-
EE2505-1.5	2	3	3	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	S. K. Bhattacharya Birjindersingh, "Control of electrical machines", New Age International.
2.	Gary J. Rockis & Glen A. Mazura, "Electrical Motor Controls", 5th Edition, ISBN number is 9780826912268

REFERENCE BOOKS:

1.	Stephen L. Herman, "Industrial Motor Control", Delmar Publishers, Inc., latest Edition.

E Books / MOOCs/ NPTEL

1.	https://www.coursera.org/learn/motors-circuits-design
2.	http://ww1.microchip.com/downloads/en/appnotes/00894a.pdf

NON-CONVENTIONAL ENERGY SOURCES

Course Code:	**EE2506-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	To understand the principle of extraction of energy from conventional, nonconventional sources
2.	To understand the working principle and applications of solar based thermal, electrical and PV systems.
3.	To justify the usage of energy storage techniques and understand the process of design and implement wind based energy conversion systems.
4.	To understand the process of design and implement biomass based energy conversion systems

UNIT-I

Energy Sources	**03 Hours**
Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources, Conventional Energy Resources- Availability and their Limitations, Non-Conventional Energy Resources- Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario	
Solar Energy Basics	**05 Hours**
Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems), Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer	
Solar Thermal Systems	**04 Hours**
Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, Concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green House.	
Solar Electric Systems	**04 Hours**
Solar Thermal Electric Power Generation, Solar Pond and Concentrating Solar Collector(Parabolic Trough, Parabolic Dish, Central Tower Collector), Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems- stand-alone and grid connected, Applications- Street lighting, Domestic lighting and Solar Water pumping systems.	

UNIT-II

Energy Storage	**04 Hours**
Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)	
Wind Energy	**04 Hours**
Introduction, Wind and its Properties, History of Wind Energy Wind Energy Scenario – World and India. Basic principles of WECS, Classification, Parts of a WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS. Wind site selection consideration, Advantages and Disadvantages of WECS.	
Biomass Energy	**06 Hours**

Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, Factors affecting biogas generation, types of biogas plants- KVIC and Janata model, Biomass program in India

UNIT-III

Energy From Ocean	**05 Hours**

Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plant, Estimation of Energy – Single basin and Double basin type TPP (no derivations, Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle), Hybrid cycle, Site-selection criteria, Biofouling, Advantages & Limitation of OTEC

Emerging Technologies	**05 Hours**

Fuel Cell, Small Hydro Resources, Hydrogen Energy and Wave Energy (Principle of Energy generation using block diagrams, advantages and limitations)

Course Outcomes: At the end of the course student will be able to

1.	Describe non-conventional energy sources and solar radiation geometry to estimate and measure solar radiation.
2.	Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3.	Describe energy storage methods and wind–energy conversion systems to understand the factors influencing power generation.
4.	Review the biomass conversion technologies to design biomass-based energy systems.
5.	Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging non-conventional energy technologies.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2506-1.1	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.2	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.3	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.4	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.5	2	3	-	-	-	1	2	1	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Rai G. D., “Non-Conventional Sources of Energy”, 4th Edition, Khanna Publishers, New Delhi, 2007.

REFERENCE BOOKS:

1.	Mukherjee D. and Chakrabarti, S., “Fundamentals of Renewable Energy Systems”, New Age International Publishers, 2005.
2.	Khan, B. H., “Non-Conventional Energy Resources”, TMH, New Delhi, 2006.
3.	S. P. Sukhumi, J. K. Nayak “Solar Energy: Principles Collection and Storage”, 3rd edition, McGraw-Hill Education (India) , 2009.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108108078

ELEMENTS OF YOGA

Course Code:	**HU1501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To give a brief history of the development of Yoga
2.	Identify names of different classical texts on Yoga
3.	To illustrate how Yoga is important for healthy living
4.	To explain the Asanas and other Yogic practices
5.	To explain, how Yoga practices can be applied for overall improvement

UNIT-I

Yoga	**09 Hours**
Meaning and initiation, definitions and basis of yoga, History and development, Astanga yoga, Streams of yoga. Yogic practices for healthy living. General guidelines for Yoga practices for the beginners: Asanas, Pranayama.	
Classification of Yoga and Yogic texts	**07 Hours**
Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas.	

UNIT-II

Yoga and Health	**06 Hours**
Concept of health and Diseases-Yogic concept of body – pancakosa viveka, Concept of disease according to Yoga Vasistha.	
	04 Hours
Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health.	
Applied Yoga for elementary education	**04 Hours**
Personality development- physical level, mental level, emotional level. Specific guidelines and Yoga practices for - Concentration development, Memory development	

UNIT-III

Yoga and physical development	**05 Hours**
Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits.	
	05 Hours
Specific guidelines and Yoga practices for – Flexibility, Stamina, Endurance (Surya Namaskara)	

Course Outcomes: At the end of the course student will be able to

1.	Understand a brief history of the development of Yoga
2.	Know important practices and principles of Yoga
3.	Explain how Yoga is important for healthy living
4.	Practice meditation to improvement of concentration etc.
5.	Have knowledge about specific guidelines of yoga practices

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1501-1.1	-	-	-	-	-	1	-	-	1	-	-	1

HU1501-1.2	-	-	-	-	-	1	-	-	1	-	-	3
HU1501-1.3	-	-	-	-	-	2	-	-	1	-	-	3
HU1501-1.4	-	-	-	-	-	3	-	-	2	-	-	3
HU1501-1.5	-	-	-	-	-	2	-	-	2	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	B. K. S. Iyengar, “Light on Yoga: The Classic Guide to Yoga by the World’s Foremost Authority”, Thorsons publisher 2016.
2.	Makarand Madhukar Gore, “Anatomy and Physiology of Yogic Practices: Understanding of the Yogic Concepts and Physiological Mechanism of the Yogic Practices”, Motilal Banarsidass Publishers; 6 edition (2016).
3.	Swami Satyananda Saraswati, “Asana, Pranayama, Mudra and Bandha: 1”, Yoga Publications Trust.

REFERENCE BOOKS:

1.	Ann Swanson, "Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice".
2.	Dianne Bondy, "Yoga for Everyone : 50 Poses For Every Type of Body".

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.swayam2.ac.in/aic19_ed29/preview
2.	https://youtu.be/FMf3bPS5wDs

INTELLECTUAL PROPERTY RIGHTS

Course Code	**HU1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Understand the creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2.	Analyze different types of protection for inventions, different types of agreements and treaties for Intellectual properties with an ability to examine patent types, specifications and patent search and database for 'prior art'.
3.	Understand the basic procedure of drafting claims, apply for patents, other legal forms of intellectual property rights and also to examine the protocol involved in protection of inventions like patents.

UNIT - I

Introduction to Intellectual Property	**08 Hours**

Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.

Agreements and Treaties	**08 Hours**

History - General Agreement on Trade and Tariff (GATT). Indian Position vis-a-vis WTO and Strategies; TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities – Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2017

UNIT - II

Basics of Patents and Concept of Prior Art	**08 Hours**

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in the context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.)

Patent filing procedures	**08 Hours**

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies.

UNIT - III

Case Studies	**08 Hours**

Patents: Biological Cases - i) Basmati rice ii) Turmeric iii) Neem; Non-biological cases – (i) TVS V/S Hero, (ii) Samsung V/S Nokia – Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition; Technology transfer and license agreements (US anti-HIV drug license to Africa).

Course Outcomes: At the end of the course student will be able to

1.	Have a General understanding of the Intellectual Property Rights.
2.	Have awareness of different forms of intellectual property rights, national and international IPR related legislations.
3.	Have a general understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.
4.	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5.	Be aware and have a general understanding of patenting procedures and licensing.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1502-1.1	-	3	3	2	-	3	-	-	2	2	-	3
HU1502-1.2	2	2	3	-	-	3	-	3	1	1	2	2
HU1502-1.3	2	-	-	2	-	3	-	-	2	2	2	3
HU1502-1.4	-	-	1	1	-	3	-	-	1	2	-	3
HU1502-1.5	3	2	1	-	-	3	-	-	3	1	-	2

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	BAREACT, "Indian Patent Act 1970 Acts & Rules", Universal Law Publishing Co. Pvt. Ltd., 2007.
2.	Kankanala C., "Genetic Patent Law & Strategy", 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
3.	Subbaram N.R., "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4.	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
5.	Intellectual Property Today: Volume 8, No. 5, May 2001.
6.	M B Rao, "WTO and International Trade", Vikas Publishing House Pvt. Ltd.
7.	Correa, Carlos M. "Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options", Zed Books, New York 2000.
8.	Wadehra, B. L. "Law relating to patents, trademarks, copyright designs & geographical indications", 2 ed. Universal Law Publishing 2000.
9.	Sinha, Prabhas Chandra, "Encyclopedia of Intellectual Property Rights", 3 Vols. Eastern Book Corporation, 2006.
10.	Rachna Singh Puri and Arvind Vishwanathan, “Practical Approach to Intellectual Property Rights”; I. K. International Publishing House Pvt. Ltd.

E-RESOURCES:

1.	http://www.w3.org/IPR/
2.	http://www.wipo.int/portal/index.html.en
3.	http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4.	www.patentoffice.nic.in
5.	www.iprlawindia.org/

INTRODUCTION TO GERMAN LANGUAGE

Course Code	**HU1503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical

Course Objectives:

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

UNIT - I

15 Hours

Introduction: Mein Name ist (saying who you are, greeting people and saying goodbye, asking people where they come from and where they live. Language point: I and you), Lesen der politischen Karte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vier Jahreszeiten, die Jahre
Mir geht es gut: Asking people how they are, saying how you are, saying which cities and counries people come from, Language points: verb endings),
Wie schreibt man das (how do you write that?) Counting from 1-100 and above, alphabet, spelling our names and words, talking about us and them. Language points: Yes-no questions

Artikel (Articles): As in English, there are definite (der/die/das) and indefinite (ein/eine) articles:
the der/die/das; a/an ein/eine
Die vier Fälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1)
Deklination des bestimmten Artikels der/die/das
Deklination des unbestimmten Artikels ein/eine
(Deklination/Declension: the variation of the form of a noun, pronoun, or adjective, by which its grammatical case, number, and gender are identified)
Deklination von Substantiven (Declension of nouns) (Singular and Plural)
(German nouns are declined by attaching certain endings to them, according to case, number and gender. This helps to differentiate between subjects, objects and indirect objects).

Nominativ und Akkusativ(nominative and accusative cases)
The verb determines the case of the noun. Some verbs only go with the nominative, others only with the accusative (or the dative). Thus, German verbs are either transitive or intransitive.
(Nominative and accusative cases) Intransitive Verben (intransitive verbs) Transitive Verben (transitive verbs)

Negation „kein/e/er "(negation with „kein/e/er ") (Singular und Plural) The negation of the indefinite article (ein/eine/ein) is kein/keine/kein. For this, you just have to put a „k" at the beginning of the declined form of ein/eine/ein. Peter sieht ein Haus. Negation Peter sieht kein Haus. (Peter sees a house. Negation Peter does not see a house.) (With examples, writing and hearing exercises, and German to English Glossary as applicable)
UNIT - II
14 Hours
Dativ (the dative) (You are already familiar with verbs which require a direct accusative object in addition to the subject, which is in the nominative case. But there also some verbs which require a dative object besides the subject. To identify the dative object you ask "(To) whom?") Der Plural (the plural) There are many different forms of the plural in the German language. Principally, the gender and the ending of the noun determine the plural form. Then, you either attach a plural ending to the noun, change a vowel, or keep the noun as it is in the singular. Das Personalpronomen (the personal pronoun) The personal pronoun is a substitute for a noun. Its forms are determined by the case, number and gender of the noun which is to be replaced. Die Formen des Personalpronomen im Nominativ (The nominative forms of the personal pronoun): Präpositionen (prepositions) German prepositions are followed by an object, either in the accusative or the dative case.Some prepositions always take an accusative object, others always a dative object. But thereare also prepositions which can be followed by both. In this case, the question "Where(to)?" (accusative) or "Where?" (dative) determines the case of the object. Präpositionen mit Akkusativ und Dativ (Prepositions with accusative and dative) 1.Präpositionen mit Akkusativ (prepositions with accusative) 2.Präpositionen mit Dativ (prepositions with dative) 3.Präpositionen mit Akkusativ oder Dativ (prepositions with accusative or dative) (With examples, writing and hearing exercises, and German to English Glossary as applicable)
UNIT - III
11 Hours
Konjugation von Verben im Präsens (Conjugation of verbs in present tense) Verbs are conjugated by attaching certain endings, depending on the person and number ofthe subject. Trennbare und untrennbare Verben (separable and inseparable verbs)

Verbs with prefixes are dinstinguished between separable and inseparable verbs.
The prefix of an inseparable verb must never be separated from the stem. Here the stress is on the stem: be-kommen. The prefix of a separable verb gets separated from the stem when the verb is conjugated. In the infinitive, the stress is on the prefix: an-kommen
1.Trennbare Verben (separable verbs)
2.Untrennbare Verben (inseparable verbs)

Konjugation von Verben im Perfekt
(Conjugation of verbs in present perfect)
The present perfect (Perfekt) describes something which happened in the past and isespecially used in spoken German. It is formed with the present tense form of „haben“ or
„sein“ and the past participle of the main verb.
1. Die Bildung des Partizips
(the formation of the past participle)
2. Die Bildung des Perfekts mit „haben“ und „sein“
(the formation of the present perfect with „haben“ and „sein“)

Modalverben (modal verbs)
A modal verb is rarely used as a main verb; instead, it usually modifies the main verb. Whilethe main verb remains in the infinitive, the modal verb is conjugated.
In German, there are 7 modal verbs:
können (can/be able), dürfen (may/be allowed), wollen (want),
müssen (must/have to), sollen (shall), mögen (to like), möchten (wish/would like)

1. Konjugation der Modalverben
(Conjugation of the modal verbs)
2. Stellung des Modalverbs im Satz
(Position of the modal verb within a sentence)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

Course Outcomes: At the end of the course student will be able to

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1503-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.4	-	-	-	-	-	3	-	-	2	1	-	1

HU1503-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

TEXT BOOKS:

1.	Ulrich Haessermann, Georg Dietrich, Christianne C. Guenther, Diethelm Kaminski, Ulrike Woods and Hugo Zenker, Sprachkurs Deutsch Neusaffung 1, Unterrichtswerk fuer Erwachsene, Verlag Moritz Diesterweg, Universitaetsdruckerei H. Stuertz AG Wuerzburg, 1989.
2.	Paul Coggle and Heiner Schenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden & Stoughton Educational, UK, 2001
3.	Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in, – 1 September 2011

REFERENCE MATERIALS:

1.	Deutsche Sprachlehre für Ausländer.
2.	Themen Aktuell (Text and workbook).
3.	Deutsch als Fremdsprache 1A.
4.	Tangram Aktuell 1A/1B (Text and workbook).
5.	Wherever required the Videos/Audios are also played in the class room sessions

E-RESOURCES:

1.	https://onlinecourses.nptel.ac.in/noc21_hs30/preview NPTEL-Swayam, German-I by Prof. Milind Brahme | IIT Madras
2.	https://www.traingerman.com/en/ powered by Sprachinstitut TREFFPUNKT Online

INTRODUCTION TO JAPANESE LANGUAGE

Course Code	**HU1504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department:

Course Objectives:

1.	Have basic spoken communication skills
2.	Write Simple Sentences
3.	Listen and comprehend basic Japanese spoken Japanese
4.	Read and understand basic Japanese characters including Kanji

UNIT - I

(Lessons 1-6) **15 Hours**

Grammar – Introduction, Alphabets, Accents, Noun, Pronoun, Present Tense, Past tense
Vocabulary – Numbers, Days, week days, months, Seasons, Nature, Dialogs and Video Clips

UNIT - II

(Lessons 7-13) **14 Hours**

Communication skills – Time, Addective, Seasons, Conversation, Q&A, Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colours, Features etc.

UNIT - III

(Lessons 14-20) **11 Hours**

Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips

Course Outcomes: At the end of the course student will be able to

1.	Understand Simple words, expressions and sentences, spoken slowly and distinctly
2.	Speak slowly and distinctly to comprehend
3.	Read and Understand common words and sentences
4.	Ask Basic questions and speak in simple sentences
5.	Write Hiragana/Katakana and Kanji (120) characters.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1504-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND CAPABILITIES

Course Code	**HU1505-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**

Total Teaching Hours	40+0+0+0	CIE + SEE Marks	50+50

Teaching Department: Chemistry

Course Objectives:

1.	To create evolved youth, who will be equipped to contribute in the development of the nation.
2.	To train students so as to achieve their physical and mental endurance. To acquire body language of smart soldier and to inculcate the sense of authority by commanding the troop under him/her.
3.	To inculcate spirit of adventure, undertake adventure activities, to hone leadership qualities and risk-taking abilities.
4.	To understand and develop life skills, soft skills and to improve emotional quotient of the student.
5.	To impart basic military training, to develop awareness about the defense forces and expose learners to military ethos / values

UNIT - I

NCC: Aims, Objectives and Organization	**07 Hours**
NCC General, Aims, Objectives and Organization of NCC. Duties of NCC Cadets, NCC Camps: Types and Conduct. National Integration: Importance and Necessity, Unity in Diversity.	
Personality Development	**07 Hours**
Self-Awareness, Empathy, Critical and Creative Thinking, Decision Making and Problem Solving. Communication Skills, Coping with stress and emotions. Leadership: Traits, Indicators, motivation, moral values, Honor Code. Social Service and Community Development.	

UNIT - II

Naval Communication and Seamanship	**08 Hours**
Naval Communication: Introduction, Semaphore, Navigation: Navigation of Ships- Basic requirements, Chart work. Seamanship: Introduction to Anchor work, Rigging Capsule, Boat work- Parts of Boat, Boat pulling instructions, Whaler sailing instructions. Ship Modeling.	
Disaster management and environmental awareness	**08 Hours**
Disaster Management- Organization, Types of Disasters, Essential Services, Assistance, Civil Defence organization. Adventure Activities. Dos and Don’ts, Fire services and Firefighting, Environmental Awareness and Conservation.	

UNIT - III

Naval Orientation	**10 Hours**
Naval Orientation- Armed Forces and Navy Capsule, EEZ Maritime Security & ICG. Border & Coastal Areas: Security setup and Boarder/Coastal management in the area. Naval Orientation: Modes of Entry- IN, ICG, Merchant Navy. Border and Coastal areas: Security Challenges & role of cadets in Border management	

Course Outcomes: At the end of the course student will be able to

1.	Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.
2.	Demonstrate the sense of discipline, improve bearing, smartness, turnout and develop the quality of immediate and implicit obedience of orders, with good reflexes.
3.	Acquaint, expose & provide knowledge about Army/Navy/ Air force and acquire information about expanse of Armed Forces, service subjects and important battles.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2
HU1505-1.1	-	-	-	-	-	3	3	1	-	-	-	-	-	-
HU1505-1.2	-	-	-	-	-	3	3	-	-	-	-	-	-	-
HU1505-1.3	-	-	-	-	-	-	-	-	1	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. R.K. Guptha, "Cadets Handbook", Ramesh Publishing House, New Delhi.

OVERVIEW OF INDIAN CULTURE

Course Code	**HU1506-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2.	To understand the local culture and its vibrancies.
3.	To develop awareness about Indian Society, Culture and Arts under Western rule.
4.	To comprehend different dimension and aspects of the Indian culture and arts.
5.	To appreciate cultural performances in India.

UNIT - I

Knowing Culture	**08 Hours**
What is Culture, Different aspects of Culture, Cultural expression, Importance of Culture	
Influence of Culture	**07 Hours**
Relationship of Culture with: Language, Religion and History, Gender	

UNIT - II

Media and Culture	**07 Hours**
Role of News Papers, Indian Cinema, Music, Advertisements	
Languages, Literature and Culture	**07 Hours**

Role of Sanskrit, Vedas, Upanishads, Ramayana and Mahabharata, Puranas, other Sanskrit Literature, Buddhist and Jain Literature, Dravidian Languages and Literature, North Indian Languages and Literature, Subaltern Literature

UNIT - III

Arts and Culture	**07 Hours**
Indian Theatre and Performing Arts, Ritual performances, and Tuluva cultural and ritual performances.	
(Self-study Component) **Contribution of Indian History to Culture**	**04 Hours**

Ancient India – Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during the Mauryan Empire (Ashoka), the Guptas, the South Indian Dynasties – the Cholas, Nalanda as a Centre of Learning.
Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Bhakti Movement, Folk Arts, Rise of Modern Indian Languages.
Modern India – British Ruling and its impact on Indian Culture, Social and Religious Reforms, Indian National Movement and Achievement of Independence.

Course Outcomes: At the end of the course student will be able to

1.	Examine how the culture has a very important role in human life and growth of human civilization and have a general awareness on historical perspective of growth of Indian Culture and Arts.
2.	Appreciate their own local culture from an academic perspective.
3.	Know about the impact of Western Rule in India and Indian Struggle for Freedom and also its impact on Indian Culture and Arts and able to appreciate and the role of language in connecting people, growth of culture and arts beyond the barriers of religion and ages.
4.	Take interest in learning these forms of arts, and also appreciate and preserve them for the future generations feeling proud of Indian Culture, Arts and Architecture.
5.	Appreciate art performances in India which will enable them to get exposed to an artistic sphere, which eventually help them to be creative and imaginative.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1506-1.1	-	1	-	-	-	3	-	3	3	1	-	3
HU1506-1.2	-	-	-	2	-	3	-	2	3	3	-	3
HU1506-1.3	-	-	-	-	-	3	-	1	-	-	-	1
HU1506-1.4	-	-	-	-	-	3	-	2	1	2	-	3
HU1506-1.5	-	-	-	-	-	3	-	3	3	3	-	2

1: Low 2: Medium 3: High

PHILOSOPHY

Course Code	**HU1507-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Visiting

Course Objectives:

1.	To provide a new understanding based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.
2.	To introduce an orientation course for humanities courses in general and for philosophy courses in particular.
3.	To relate philosophy to literature, culture, society and lived experience.
4.	To train students in already available philosophical systems.
5.	To bridge the gap between theory and practice.

UNIT - I

Knowledge (Vidya) and Ignorance (Avidya)	**14 Hours**

Upanishads
Six systems orthodox and Heterodox schools of Indian philosophy
Greek philosophy

Origin of the universe

NasidiyaSukta: "Who really knows?"
Brhadaranyaka Upanishad; Chandogya Upanishad: Non-Self, real and unreal
Taithriya Upanishad: SikshaValli
Plato's Symposium: Lack as the source if desire and knowledge.
Socratic method of knowledge as discovery
Language: word as root of knowledge (Bhartrahari's Vakyapadiyam)
Fourteen Knowledge basis as a source of Vidya: Four Vedas, six auxiliary sciences (vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.

UNIT - II

Knowledge as Power	**16 Hours**

Francis Bacon. Knowledge as both power and self- realization in Bhagavad Gita.

Knowledge as Oppression

M. Foucault. Discrimination between Ram and Satyam in Indian Philosophy.

Knowledge as Invention

Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

UNIT - III

	10 Hours

Knowledge about the self, transcendental self; knowledge about society, polity and nature
Knowledge about moral an ethics codes.

Course Outcomes: At the end of the course student will be able to

1.	To provide a new understanding based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.
2.	To introduce an orientation course for humanities courses in general and for philosophy courses in particular.
3.	To relate philosophy to literature, culture, society and lived experience.
4.	To train students in already available philosophical systems.
5.	To bridge the gap between theory and practice.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1507-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Copleston, Frederick, "History of Philosophy", Vol. 1. Great Britain: Continuum.
2.	Hiriyanna, M. , "Outlines of Indian Philosophy", Motilal Banarsidass Publishers; Fifth Reprint edition, 2009.
3.	Sathaye, Avinash, "Translation of Nasadiya Sukta".
4.	Raju, P. T. "Structural Depths of Indian Thought", Albany: State University of New York Press.
5.	Plato, Symposium, Hamilton Press

PRINCIPLES OF PHYSICAL EDUCATION

Course Code	**HU1508-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Physical Education

Course Objectives:

1.	Express understanding of constitution of sports organizations
2.	Demonstrate considerate familiarity of various food practices
3.	Grasp understanding of first aid and physical education
4.	Awareness on the importance of exercise
5.	Leadership skills and the rules of different sports

UNIT - I

15 Hours

History of Physical Education - Olympic games, Modern Olympic games, Olympic Ideals & Objectives, Olympic Symbols, Olympic Flag, Olympic Emblem, Olympic Motto, Olympic Flame, Asian games

International Olympic Committee (IOC), Indian Olympic Association (IOA)

Sports awards - Eligibility, Objectives & Criteria

Yoga - Meaning and Importance

World Health organization (WHO)

UNIT - II

14 Hours

Concept of Health - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students, Physical Fitness and Exercises.

Food and Nutrition - Food & Nutrition Defined, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins

Balanced Diet & Malnutrition

Health Education - Meaning of Health Education, Health Education Defined, Scope of Health Education, Importance of Health Education.

Posture - Concept of Posture, Correct Postures, Common Postural Defects

First Aid - First Aid Defined, Need and importance of First Aid, The Requisites of First Aid, Scope of First Aid, Qualities of a First Aider, Fundamental Principles to be followed and the Duties to be performed by the First Aider, First Aid in Different Cases.

Physical Education - Concept of Physical Education, Physical Education Defined, Importance of Physical Education, Scope of Physical Education, Aims and Objectives of Physical Education.

Teaching Aid in Physical Education

Competition - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

UNIT - III

11 Hours

Training in Sports – Meaning, Principles, Warming Up & Limbering Down

Importance of Anatomy and Physiology in Physical Education, Oxygen Debt and Second wind

Leadership and Supervision – Leadership, Qualities of a good leader in Physical Education, Types of Leadership in Physical Education - 1. Teacher Leadership 2. Student Leadership.

Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate knowledge of structure of the world sports organizations
2.	Display understanding of different type of food and nutrition for a healthy diet
3.	Comprehend awareness of first aid and physical education
4.	Elucidate about training and the importance of Physical Education
5.	Aware of leadership skills and the knowledge of various sports

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1508-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

COMMON SENSE AND CRITICAL THINKING

Course Code	**HU2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**HU1001-1 (Technical English)**		

Teaching Department: Humanities

Course Objectives:

1.	To Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

UNIT - I

Common sense and Emotional Intelligence — **15 Hours**

Common sense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Common sense and Critical Thinking;Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence

Etiquettes & Workplace

Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross-Cultural Understanding; Cultural Sensitivity, Impact of social media in Workplace

UNIT - II

Social Networking Sites and its Impacts — **15 Hours**

Emergence of social media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of social media, Offline Norms & Online Behaviour

Gender and Body

Gender & Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender Schooling, Representations of Body, Objectification, Gender Perspectives of Body, Different Ways of Seeing the Body, Discipline & Coercion, ISA & RSA

UNIT - III

Writing — **10 Hours**

Types of Writing, Note Taking Methods, Plagiarism

Reading

Styles of Reading, Types of Reading, Scanning, Skimming

Course Outcomes: At the end of the course student will be able to

1.	Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU2501-1.1	-	3	-	-	-	-	-	-	3	3	-	3
HU2501-1.2	-	2	-	-	-	-	-	3	2	3	-	2

HU2501-1.3	-	3	-	-	-	-	-	-	2	2	-	3
HU2501-1.4	-	3	-	-	-	-	-	-	2	2	-	3
HU2501-1.5	-	2	-	-	-	-	-	-	3	3	-	2

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Geetha.V. Gender. Kolkatta: Web Impressions, 2009.
2.	Bailey, Jane, et al. "Negotiating with Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." Journal of Communication Enquiry 37.2 (2013): 91-112.
3.	Barry, Peter. "Beginning Theory". New Delhi: Viva Books, 2010.
4.	Berger, John. "Ways of Seeing". London: Penguin Books, 1977.
5.	Cranny-Francis, Anny, et al. "Gender Studies: Terms and Debates". New York: Palgrave Macmillan, 2003.
6.	Gauntlett, David. "Media, Gender and Identity: An Introduction". London: Routledge, 2008
7.	Pilcher, Jane, and Imelda Whelehan. "50 Key Concepts in Gender Studies". London: Sage, 2004. Print.
8.	Jeanne, Haraway Donna. Simians, Cyborgs, and Women. London: Free Association Books, 1991. Web.
9.	Koskela, Hille. "Webcams, TV Shows and Mobile Phones: Empowering Exhibitionism." Surveillance & Society 2.3 (2004): 199-215.Web.

E-RESOURCES:

1.	http://www.cyberpsychology.eu/view.php?cisloclanku=2009061501/ >.
2.	http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3.	http://eprints.rclis.org/19790/>.

LINGUISTICS & LANGUAGE TECHNOLOGY

Course Code	**HU2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**HU1001-1 (Technical English)**		

Teaching Department: Humanities

Course Objectives:

1.	Introspect about the consciousness in one’s language
2.	Learn pronunciation and how the process helps to communicate effectively.
3.	Build contextual speech and writing with the pedagogy in sentence structure.
4.	Improve skill of applying language to enunciate words.
5.	Progress on the speech aspects by understanding the acquisition of Second Language.

UNIT - I

Introduction to Linguistics	**08 Hours**

Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive).

Phonology and Morphology	**08 Hours**

Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis.

UNIT - II

Syntax	**16 Hours**

Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case

UNIT - III

Sociolinguistics & Psycholinguistics, Artificial Intelligence	**08 Hours**

Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.

Course Outcomes: At the end of the course student will be able to

1.	Understand the importance of language and its facets.
2.	Demonstrate knowledge of sounds and competence in process of word building.
3.	Evolve to reason the constituent parts of a sentence.
4.	Understand the techniques of how ‘meaning’ is applied.
5.	Analyze errors in day-to-day-conversations and how language is related to society.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU2502-1.1	-	1	-	-	1	1	-	-	1	-	-	2
HU2502-1.2	-	-	2	-	-	-	-	-	2	2	-	-
HU2502-1.3	2	3	-	3	-	-	-	-	3	2	-	-
HU2502-1.4	-	-	-	-	2	-	-	-	1	2	-	-
HU2502-1.5	-	2	-	-	-	2	1	-	-	-	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Akmaijan, A, R. A. Dimers and R. M. Harnish. "Linguistics: An Introduction to Language and Communication". London: MIT Press, 1979.
2.	Chomsky, Noam. "Language in Mind". New York: Harcourt Brace Jovanovich, 1968.
3.	Fabb, Nigel. "Sentence Structure". London: Routledge, 1994.
4.	Hockett, C. "A Course in Modern Linguistics". New York: Macmillan, 1955.
5.	O'Grady, W., O. M. Dobrovolsky and M. Aronoff. "Contemporary Linguistics: An Introduction". New York: St. Martin's Press, 1991.
6.	Pride, J. B. and J. Holmes. "Sociolinguistics". Harmondsworth: Penguin, 1972.
7.	Richards, J. C. "Error Analysis: Perspectives in Second Language Acquisition". London: Longman, 1974.
8.	Salkie, R. "The Chomsky Update: Linguistics and Politics". London: Unwin Hyman Ltd., 1990.
9.	Sinclair, J. M. C. H. and R. M. Coulthard. "Towards an Analysis of Discourse". Oxford: OUP, 1975.
10.	Thomas, Linda. "Beginning Syntax". Oxford: Blackwell, 1993.

11.	Verma, S. K. and N. Krishnaswamy. "Modern Linguistics: An Introduction". New Delhi: OUP, 1989.
12.	Wekker, Herman and Liliane Haegeman. "A Modern Course in English Syntax". Kent: Croom Helm, 1985.

INTRODUCTION TO CYBER SECURITY

Course Code:	**IS2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**IS1651-1**		

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Define the area of cybercrime and forensics and to understand the security threat
2.	Explain the motive and causes for cybercrime, detection, and handling.
3.	Investigate Areas affected by cybercrime.
4.	Illustrate tools used in cyber forensic

UNIT-I

Introduction to Cyber Security	**15 Hours**

Concepts of Cyber Security, Formal Methods of Security Validation, CIA framework-Confidentiality, Integrity and Authenticity, Threat modelling, Domains of cyber security, Security attacks, Security services, Security Mechanisms, Fundamental security design principles, Types of Cyber Threat.

UNIT-II

Tools and methods used in Cybercrime	**14 Hours**

Introduction, Proxy Servers and Anonymizers, Intruders and Hackers, Insider threats, Cybercrimes. Network Threats: Active/ Passive – Interference – Interception –Impersonation – Worms –Virus – Spam's – Ad ware - Spy ware – Trojans and covert channels –Backdoors – Bots – IP, Spoofing - ARP spoofing - Session Hijacking, Introduction to Phishing, Identity Theft (ID Theft).

UNIT-III

Understanding Computer Forensics	**11 Hours**

Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

Course Outcomes: At the end of the course student will be able to

1.	Comprehend the Cybercrime and its origin
2.	Analyse Security Threat Management and understand the security elements.
3.	Apply tools and methods used in Cyber crimes
4.	Analyse Phishing and ID Theft
5.	Comprehend Digital Forensics

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
IS2501-1.1	2	-	-	-	-	1	-	3	-	-	-	-
IS2501-1.2	-	3	-	1	-	2	-	-	2	-	-	-
IS2501-1.3	-	3	2	-	-	-	-	-	-	-	-	-
IS2501-1.4	2	-	-	-	-	2	-	-	-	-	-	-
IS2501-1.5	-	-	-	-	-	-	-	3	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson Education, 2006.

2. Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.

3. Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013.

REFERENCE BOOKS:

1. Thomas J. Mowbray, “Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions”, John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1, 2014.

2. James Graham, Ryan Olson, Rick Howard, “Cyber Security Essentials", CRC Press, 15-Dec 2010. Anti- Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw-Hill.

3. Santosh B. J., K. V. S. S. S. S. Sairam, Shubham Kumar, Chandu Jagan Sekhar M, “Information and Cyber Security”, Scientific International Publishing House, ISBN- 978-93-5625-694-1.

PYTHON APPLICATION PROGRAMMING

Course Code:	**IS2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1002-1**		

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Construct Python programs using data types and looping.
2.	Design object-oriented Python programs using classes and objects.
3.	Design useful stand-alone and CGI applications in

UNIT-I

Functions, Classes and OOP — **15 Hours**

Functions: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions
Classes and OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

UNIT-II

Lists, Tuples, and Dictionaries — **14 Hours**

Lists, tuples, and dictionaries: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing, and replacing values; traversing dictionaries.
File Handling: Reading From Text Files, Writing to Text Files, Working with Excel Sheets ,CSV, PDF, Word,

UNIT-III

Essential Python Libraries — **11 Hours**

Working with SciPy, Numpy, Matplotlib, Pandas.
Graphical user interfaces: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames Simple CGI form.

Course Outcomes: At the end of the course student will be able to

1.	Demonstrate the basics of Python programming like data types and looping
2.	Apply the basic data structures in solving the problems
3.	Experiment with usage of functions in a given problem
4.	Develop Objects by creating classes and apply object-oriented features
5.	Develop applications in Python using File Programming &User Interface

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2502-1.1	2	-	-	-	2	-	-	-	-	-	-	3
IS2502-1.2	2	-	-	-	2	-	-	-	-	-	-	3
IS2502-1.3	2	-	-	-	2	-	-	-	-	-	1	3
IS2502-1.4	-	-	-	-	-	-	-	-	-	-	-	-
IS2502-1.5	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	Kenneth A. Lambert, "The Fundamentals of Python: First Programs", 2011, Cengage Learning, ISBN: 978-1111822705.

SOFTWARE ENGINEERING PRACTICES

Course Code:	**IS2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1002-1**		

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Outline software engineering principles and activities involved in building large software programs.
2.	Explain the importance of architectural decisions in designing the software.
3.	Describe the process of Agile project development.
4.	Recognize the importance of software testing and describe the intricacies involved in software evolution.
5.	Identify several project planning and estimation techniques and explain the importance of software quality.

UNIT-I

Introduction	**15 Hours**
Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Case Studies.	
Software Processes	
Models: Waterfall Model, Incremental Model and Spiral Model; Process activities	
Requirements Engineering	
Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.	

UNIT-II

System Models	**15 Hours**
Context models, Interaction models, Structural models, Behavioral models.	
T Architectural Design	
Architectural design decisions. Architectural Views and patterns, Application architectures.	
Design and implementation	
Object oriented Design using UML.	
Agile Software Development	
Agile methods, Plan-driven and agile development, Extreme Programming, Agile project management.	

UNIT-III

Project Management	**10 Hours**
Risk management, Teamwork.	
Project Planning	
Software pricing, Plan-driven development, Project Scheduling.	
Quality Management	
Software quality, Reviews and inspections, Software measurement and metrics, Software standards.	

Course Outcomes: At the end of the course student will be able to

1.	Recognise the basics of software system, component, process and Software Requirement Specification to meet desired needs within realistic constraints and outline the professional and ethical responsibility

2.	Describe the waterfall, incremental and iterative models and architectural design in implementing the software
3.	Make use of the techniques, skills, modern engineering design tools and agile methods necessary for engineering practice.
4.	Describe the methods for maintaining software system.
5.	Discuss project planning and management and illustrate the quality of software products

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2503-1.1	-	3	1	-	-	-	-	2	-	-	-	-
IS2503-1.2	1	3	1	-	-	-	-	-	-	-	-	-
IS2503-1.3	1	1	3	-	-	-	-	-	-	-	-	-
IS2503-1.4	1	3	2	-	-	-	-	-	-	-	-	-
IS2503-1.5	1	2	2	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education, 2012.

REFERENCE BOOKS:

1.	Roger S. Pressman: "Software Engineering-A Practitioners approach", 7th Edition, Tata McGraw Hill, 2017.
2.	Pankaj Jalote: "An Integrated Approach to Software Engineering", Wiley, India, 2010.

E Books / MOOCs/ NPTEL

1.	http://agilemanifesto.org/
2.	http://www.jamesshore.com/Agile-Book/
3.	https://www.mooc-list.com/course/uml-class-diagrams-software-engineering-edx
4.	https://www.mooc-list.com/course/enterprise-software-lifecycle-management-edx

WEB TECHNOLOGIES

Course Code:	**IS2504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1002-1**		

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Illustrate the Semantic Structure of HTML and CSS
2.	Compose forms and tables using HTML and CSS
3.	Design Client-Side programs using JavaScript and Server-Side programs using PHP
4.	Illustrate the Database connectivity using PHP
5.	Examine JavaScript frameworks such as jQuery

UNIT-I

Introduction to HTML **15 Hours**

HTML tags and simple HTML forms, web site structure, HTML table, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

UNIT-II

Client side Scripting	**15 Hours**
Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,	
UNIT-III	
PHP Databases	**10 Hours**
Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, File Handling in PHP, PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, jQuery Introduction: What is jQuery, Adding jQuery in to your web pages, jQuery Syntax, jQuery Selectors, jQuery Events.	

Course Outcomes: At the end of the course student will be able to

1.	Adapt HTML and CSS syntax and semantics to build web pages
2.	Construct and visually format tables and forms using HTML and CSS.
3.	Experiment with the usage of Event handling and Form validation using JavaScript.
4.	Understand the principles of object-oriented development using PHP and Database concepts.
5.	Inspect JavaScript frameworks like jQuery which facilitates developers to focus on core features.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2504-1.1	1	2	-	2	-	-	-	-	-	-	-	1
IS2504-1.2	1	-	-	2	-	-	-	-	-	-	-	1
IS2504-1.3	1	2	-	2	3	-	-	-	-	-	-	1
IS2504-1.4	1	2	-	2	3	-	-	-	-	-	-	1
IS2504-1.5	1	-	-	2	3	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978-9332575271).

E Books / MOOCs/ NPTEL

1.	nptel.ac.in/courses/106105084/11

GRAPH THEORY

Course Code:	**MA1501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1.	Explain subgraphs, bipartite graphs, isomorphic graphs etc. Apply the concept of trees and its properties
2.	Distinguish between Hamilton and Eulerian graph. Distinguish between planar and nonplanar graphs and apply their properties to solve problems.
3.	Represent a graph in terms of adjacency matrix, incidence matrix etc. and vice-versa.
4.	Find the shortest path between two vertices in a graph. Find minimal spanning tree.

UNIT-I

Introduction to graphs	**15 Hours**

Graphs and Graph Models, digraphs, Konigsberg bridge problem. Special Types of Graphs: Subgraphs-spanning and induced subgraphs, complete graph, Bipartite Graphs. Isomorphism of graphs. Complement of a graph and its properties.
Connectivity-point and line connectivity. Trees and its properties.
Euler and Hamilton graphs and their applications.

UNIT-II

Planar graphs	**09 Hours**
Euler's polyhedron formula, outer planar graphs, applications	
Colorability	**07 Hours**
Chromatic number, five color theorem, chromatic polynomial, Applications of graph coloring.	
Matrix representation of graphs	
Adjacency matrix, incidence matrix, circuit matrix, cut set matrix, Path matrix.	

UNIT-III

Network Flows	**04 Hours**
Max -flow and Min-cut Theorem(statement), problems.	
Shortest paths in weighted graphs	
Dijkstra's algorithm to find shortest paths.	
Spanning trees	**05 Hours**
Algorithms to find a spanning tree, minimal spanning tree-Kruskal & Prim's algorithm.	

Course Outcomes: At the end of the course student will be able to

1.	Distinguish between bipartite and complete bipartite graphs, identify whether two graphs are isomorphic, find subgraphs of a graph etc.
2.	Distinguish between Eulerian and Hamiltonian graphs.
3.	Identify whether a graph is planar and to find the chromatic polynomial of a graph.
4.	Representing graphs interms of Matrices.
5.	Apply algorithmic methods to find the shortest path between two given vertices. Use a suitable algorithm to find a minimal spanning tree.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												

MA1501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
MA1501-1.2	2	1	-	-	-	-	-	-	-	-	-	-
MA1501-1.3	2	3	-	-	-	-	-	-	-	-	-	-
MA1501-1.4	3	2	-	-	-	-	-	-	-	-	-	-
MA1501-1.5	3	2	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. F. Harary, "Graph theory", Narosa Publishing House, 1988.

2. Narsing Deo, "Graph Theory with applications to Engg. and Comp. Sciences", PHI,1974.

3. Kenneth H. Rosen, "Discrete Mathematics and its applications", Tata McGraw Hill, V Edition-2003.

REFERENCE BOOKS:

1. D. B. West, "Introduction to Graph Theory", PHI,2001.

2. Chartrand and Zhang, "First Course in Graph Theory", 2012

E Books / MOOCs/ NPTEL

1. http://diestel-graph-theory.com.

2. https://nptel.ac.in/courses/111106102

NUMBER THEORY

Course Code:	**MA1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1.	Understand the divisibility of integers, study of prime numbers and basic properties of congruences.
2.	Study Fermat's little theorem and understand Euler's function.
3.	Study the existence of primitive roots and quadratic residues.
4.	Study the cryptographic applications in number theory.

UNIT-I

Divisibility and the theory of congruences	**15 Hours**

Division algorithm, Euclid's algorithm for the greatest common divisor. Linear Diophantine equations. Prime numbers, fundamental theorem of arithmetic. Basic properties of congruences, Linear congruences and Chinese reminder theorem.

UNIT-II

	07 Hours

Fermat’s theorem, Wilson’s theorem, Euler’s Phi function, Euler’s theorem.

Primitive roots and Quadratic congruences	**08 Hours**

Order of an integer modulo n, primitive roots for primes, Euler’s criterion, Legendre symbol and its properties.

UNIT-III

Cryptography	**10 Hours**

Introduction to public key cryptography, RSA cryptosystem, an application of primitive roots to cryptography.

Course Outcomes: At the end of the course student will be able to

1.	Use divisibility and Greatest common divisor in Euclidean algorithm. Solve Diophantine equations. Identify prime factorization of an integers.
2.	Understand the properties of congruences. Use Chinese reminder theorem to find solution of system of linear congruences
3.	Use Fermat's Little Theorem and Wilson's Theorem. Use of Euler’s Phi function.
4.	Identify primitive roots of an integers. Apply Euler’s criterion and Legendre symbols.
5.	Code and decode numbers in the RSA cryptosystem.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MA1502-1.1	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.2	2	3	-	-	-	-	-	-	-	-	-	-

MA1502-1.3	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.4	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.5	2	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	D. Burton, "Elementary Number Theory", McGraw-Hill, 2005.
2.	Niven, H.S. Zuckerman & H.L. Montgomery, "Introduction to the Theory of Numbers", Wiley, 2000.

REFERENCE BOOKS:

1.	H. Davenport, "The Higher Arithmetic", Cambridge University Press, 2008.
2.	G. A. Jones & J. M. Jones, "Elementary Number Theory", Springer UTM, 2007.
3.	Thomas Koshy, "Elementary Number Theory with Applications", 2nd edition, Elsevier, 2007.
4.	William J. LeVeque, "Fundamentals of Number Theory".

E Books / MOOCs/ NPTEL

1.	http://refkol.ro/matek/mathbooks/ro.math.wikia.com%2520wiki%2520Fisiere pdf_incarcate/ Elementary-Number-Theory.pdf
2.	https://nptel.ac.in/courses/111104138
3.	https://nptel.ac.in/courses/111103020

LINEAR ALGEBRA

Course Code:	**MA3501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**MA1001-1 and MA2009-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Understand the concepts of vectors, bases.
2.	Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study.
3.	Find the canonical forms and appraise its importance in various fields.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis.
5.	Learn the concepts of singular value decomposition and PCA.

UNIT-I

Vector spaces	**08 Hours**
Vector spaces, subspaces, bases and dimensions, coordinate vecotrs, null spaces and column spaces of the matrices.	
Linear Transformations	**07 Hours**
Linear transformations, rank-nullity theorem, algebra of linear transformations, change of basis, linear operators, linear functionals, transpose of a linear transformation.	

UNIT-II

Canonical Forms	**08 Hours**
Review of characteristic values, similarity of matrices, Cayley Hamilton theorem, annihilating polynomials, invariant subspaces, Jordan and rational canonical forms.	
Inner Product Spaces	**07 Hours**
Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization, Least-squares problems.	

UNIT-III

Symmetric Matrices and Quadratic Forms	**10 Hours**
Diagonalization, quadratic forms, constrained optimization, singular value decomposition and principal component analysis. Applications to linear recurrence relations.	

Course Outcomes: At the end of the course student will be able to

1.	Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
2.	Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
3.	Understand the concepts of Jordan and rational canonical forms.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.
5.	Apply techniques of constrained optimization singular value decomposition and PCA for problems arising in various engineering fields.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
MA3501-1.1	3	2	-	-	-	-	-	-	-	-	-	-

MA3501-1.2	2	2	-	-	-	-	-	-	-	-	-	-
MA3501-1.3	3	1	-	-	-	-	-	-	-	-	-	-
MA3501-1.4	3	2	-	-	-	-	-	-	-	-	-	-
MA3501-1.5	3	2	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd, 2004.
2.	David C. Lay, “Linear Algebra and its Applications”,3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.

REFERENCE BOOKS:

1.	M. Artin, "Algebra", Prentice Hall of India, 2004.
2.	Gilbert Strang, “Linear Algebra and its Applications”, 4th edition, Thomson Learning Asia, 2003.
3.	Bernard Kolman and David R. Hill, “Introductory Linear Algebra with Applications”, Pearson Education (Asia) Pte.Ltd, 7th edition ,2003.
4.	Sheldon Axler, “Linear Algebra Done Right”, Springer International Publication, Third Edition, 2015.

AUTOMOTIVE ENGINEERING

Course Code:	**ME1501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Get an idea on the different components of an engine and its types with lubrication system.
2.	Understand the fuel supply system and ignition systems used in automobiles.
3.	Demonstrate the working of transmission system.
4.	Explain the importance of suspension system, steering geometry and drives in automobiles
5.	Know the concept of braking system, tyres and emission control.

UNIT-I

Engine Components and Cooling & Lubrication Systems — **08 Hours**

SI & CI engines, Cylinder arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Choice of materials for different engine co mponents, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor.

Fuel Supply Systems for SI and CI Engines — **08 Hours**

Fuel mixture requirements for SI engines, types of carburetors, si mple carburetor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, injectors, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors.
Ignition Systems : Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive)
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Power Trains — **07 Hours**

Clutches - Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant m esh gear box, Synchromesh gear box, principle of automatic transmission, Vehicle Speed Sensors, calculation of gear ratios, Types of transmission systems. No numerical.

Drive to Wheels — **08 Hours**

Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, power steering, over steer, under steer & neutral steer, Steering angle sensors, numerical problems.
Suspension and Springs: Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system. Collective bargaining; Characteristics, Necessity, Forms Safety & Health; Industrial accidents, Safety Quality circle; Meaning, Structure
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

Brakes — **09 Hours**

Types of brakes, mechanical, compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes.
Tyres: Desirable tyre properties, Types of tyres.

Automotive Emission: Automotive exhaust emissions, sources and emission control method: EGR, SCR, Emission Standards, Exhaust sensors.
Electric Vehicles.
Pedagogy Chalk and talk method, Power Point Presentation

Course Outcomes: At the end of the course student will be able to

1.	Describe and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
2.	Explain and demonstrate the fuel supply and Ignition systems for SI and CI engines.
3.	Describe and demonstrate the transmission system
4.	Explain and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
5.	Describe and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
ME1501-1.1	3	1	-	-	-	1	-	-	3	1	-	1
ME1501-1.2	3	1	-	-	-	1	-	-	3	1	-	1
ME1501-1.3	3	1	1	-	-	1	-	-	3	1	-	1
ME1501-1.4	2	3	1	-	-	1	-	-	3	1	-	1
ME1501-1.5	3	1	1	-	-	1	1	1	3	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	S. Srinivasan, "Automotive Mechanics", Tata McGraw Hill, 2003.
2.	Kirpal Singh, "Automobile Engineering", Vol I and II, 2013.
3.	A. K. Babu, "Automotive Electrical and Electronics", Khanna Publishers, 2^{nd} edition, 2016.

REFERENCE BOOKS:

1.	R. B. Gupta, "Automobile Engineering", Satya Prakashan, 4th Edn., 1984 .
2.	Naran G, "Automobile Engineering", Khanna Publishers 2002

INDUSTRIAL POLLUTION CONTROL

Course Code:	**ME1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Know the Consequences of pollution, relationship between man and environment over the last few decades, necessity of modern awareness on pollution and how carbon audit can help in developing a carbon strategy.
2.	Identify the Importance of Meteorology in pollution control and global warming, various types of plume dispersions and its effect; analyze various levels of plume height for different pollutants.
3.	Distinguish Particulates and fly ash separation techniques such as cyclone separator, electrostatic precipitator efficiency calculations etc.
4.	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.
5.	Summarize the Effects of water, soil, plastics and odor pollution their control techniques, Different Pollution Control Acts, Legal aspects of pollution control and how these acts can help in bringing down the pollution rate.

UNIT-I

Introduction to Pollution	**08 Hours**

Man and the environment, types of pollution and its consequences, Changing environmental management concept, sustainable industrial growth, carbon audit, Ill effects of various pollutants, permissible concentration levels & AQI.

Meteorology	**08 Hours**

Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems.
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Separation techniques	**08 Hours**

Different types of Particulates, Need for Separation techniques, Sources of Particulates Matter Fly Ash Electrostatic precipitator (Problems) Theory of settling processes (Design Problems), Bag House fabric filter Cyclone separator Spray Tower Scrubbers & Venturi Scrubber

Smoke and gaseous pollutants:	**08 Hours**

Smoke- White, blue and black smoke, Sources of smoke, T,T,T-O Principle of smoke Measurement of stack smoke intensity using Ringlemann Chart and Smokescope &Bosch Smoke meter, Domestic and Industrial Incinerators-Design factors, Pollutant gaseous So2, Co, UBHC, Nox their ill effects and & control methods.
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

	08 Hours

Water, soil, noise, and odor pollution, their control methods, problems associated with nuclear reactors, Legal aspects of pollution control in India, brief details of Euro and BS standards
Pedagogy: Chalk and talk method, Power Point Presentation

Course Outcomes: At the end of the course student will be able to

1.	Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.

2.	Outline the instruments for Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants from T-Z diagrams
3.	Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency
4.	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
5.	Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
ME1502-1.1	1	-	-	1	-	3	3	2	1	2	-	3
ME1502-1.2	1	2	1	1	3	2	3	1	1	1	-	2
ME1502-1.3	1	2	2	1	1	2	3	1	1	1	-	1
ME1502-1.4	1	1	1	1	1	2	3	1	1	1	-	2
ME1502-1.5	1	-	-	1	-	2	3	1	1	1	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	"Environmental Pollution Control Engineering", Wiley Eastern Ltd.,
2.	Gilbert M Masters, "Introduction to Environmental Engineering & Science", PHI,1995
3.	C. S Rao, "Environmental Pollution Control Engineering", New Age Int.
REFERENCE BOOKS:	
1.	Henry C. Perkins, "Air Pollution", Mc-Graw Hill, 1974.
2.	W. L. Faith, "Air Pollution control", John Wiley
E Books / MOOCs/ NPTEL	
1.	http://nptel.ac.in/courses/105106119/36

SUSTAINABLE DEVELOPMENT GOALS

Course Code:	**ME1503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges
2.	Address the global challenges including poverty, inequality, climate change, environmental degradation, peace and justice.
3.	To learn more and take action.
4.	Addresses critical global challenges put forth by UN.
5.	Analyze how sustainable development can be achieved in practice.

UNIT-I

08 Hours

The origin, development and idea of the SDGs History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?

SDGs and Society — **08 Hours**

Ensuring resilience and primary needs in society In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

SDGs and Society — **14 Hours**

Strengthening Institutions for Sustainability In-depth discussion and analysis of goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions
SDGs and the Economy: Shaping a Sustainable Economy In-depth discussion and analysis of goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

SDGs and the Biosphere — **10 Hours**

Development within Planetary Boundaries In-depth discussion and analysis of goals related to clean water, climate, life below water and life on land
Realizing the SDGs: Implementation through Global Partnerships In-depth discussion and analysis of SDG 17 which aims to implement the SDGs through partnerships, finance, technology and the development of coherence between policies.
Pedagogy: Chalk and talk method, Power Point Presentation

Course Outcomes: At the end of the course student will be able to

1.	Summarize the UN"s Sustainable Development Goals and how their aims, methodology and perspectives.
2.	Analyze the major issues affecting sustainable development and how sustainable development can be achieved in practice.

3.	Identify and apply methods for assessing the achievement/possibilities of sustainable development in Nitte gram panchayath.
4.	Evaluate the implications of overuse of resources, population growth and economic growth. sustainability & Explore the challenges the society faces in making transition to renewable resource use.
5.	Create skills that will enable students to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
ME1503-1.1	1	2	1	1	1	3	3	1	1	1	-	2
ME1503-1.2	2	2	1	1	1	3	3	2	1	1	-	1
ME1503-1.3	3	2	2	1	1	3	3	2	3	1	-	1
ME1503-1.4	3	2	3	1	1	3	3	2	1	1	-	1
ME1503-1.5	1	2	2	1	1	3	3	2	2	2	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Sachs, Jeffrey D. "The age of sustainable development" Columbia University Press, 2015
2.	Gagnon, B., Leduc, R., and Savard, L., "Sustainable development in engineering: a review of principles and definition of a conceptual framework", Cahier de recherche / Working Paper 08-18, 2008.

REFERENCE BOOKS:

1.	Elliott, Jennifer, "An introduction to sustainable development", Routledge, 2012.

E Books / MOOCs/ NPTEL

1.	https://www.un.org/sustainabledevelopment/poverty/

TECHNOLOGICAL INNOVATION

Course Code:	**ME1504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand basics of operations management and Quality.
2.	Define the concept of technological innovation.
3.	Discuss Innovation management and the difference between Invention and Innovation.
4.	Appreciate the importance of Innovation as a management process and Innovation management techniques.
5.	Discuss the Innovation system, Understand the importance of Technology management and Transfer and basics of Technological Forecasting.

UNIT-I

Production and Operations Management and Introduction to Quality Concepts	**04 Hours**
Production and Operations Management: Introduction - Functions within business organizations - the operation management function - Classification of production systems. Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement - Key dimensions of Quality - Concept of cost of quality - Customers' perception of quality.	
Introduction to Technological Innovation	**09 Hours**

Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement - Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.

Startup Idea Pitching	**03 Hours**

UNIT-II

Introduction to Innovation Management and Innovation & Competitiveness	**07 Hours**

Introduction to Innovation Management: Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.

Innovation and Competitiveness: Case Study – Barriers for Innovation and Competitiveness

Innovation as a Management Process	**08 Hours**

Activities to enhance companies' capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).

UNIT-III

Innovation Systems and Technology Management & Transfer	**04 Hours**

Innovation Systems: The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.

Technology Management and Transfer: Technology Transfer - Impacts of MNCs in technology transfer

Introduction to Technological Forecasting	**05 Hours**

Introduction - Applications & Limitations of Technological Forecasting – Technology Forecasting Techniques – Exploratory Forecasting – Normative Forecasting – Delphi Technique – Problems of Technological Forecasting

Course Outcomes: At the end of the course student will be able to

1.	Define operations management and quality.
2.	Describe technological innovation and its key features for business.
3.	Discuss innovation management and the difference between invention and innovation.
4.	Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.
5.	Explain innovation systems, technology management transfer and basics of technological forecasting.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
ME1504-1.1	3	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.2	3	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.3	2	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.4	2	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.5	3	2	-	-	-	1	1	-	1	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., "Innovation and Entrepreneurship Theory, Policy and Practice", Springer, 2015.

REFERENCE BOOKS:	
1.	Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2018.
E Books / MOOCs/ NPTEL	
1.	https://krishi.icar.gov.in/jspui/bitstream/123456789/46063/1/21_Technological%20forecasting.pdf dtd 12/06/2022
2.	http://www.oipec.eu/wp-content/uploads/2017/07/Introduction-to-Technology-Forecasting.pdf dtd 12/06/2022

HUMAN RESOURCE MANAGEMENT

Course Code:	**MG1501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To develop a meaningful understanding of HRM theory, functions and practices.
2.	To understand concepts and skills recruitment.
3.	To understand the concepts of training and development.
4.	To deal with employees' grievances, safety and health types of organizations.
5.	To understand the concepts of e-HRM.

UNIT-I

Human Resource Management & HRP	**08 Hours**

Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning. Process HRP.

Recruitment	**08 Hours**

Definition, Sources and Methods of Recruitment Selection: Definition and Process of Selection. Cost benefit analysis of selection.
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods.
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Training and development	**07 Hours**

Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.

Compensation	**08 Hours**

Employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits. Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.
Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms Safety & Health; Industrial accidents, Safety Quality circle; Meaning, Structure
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

IHRM and e-HRM	**09 Hours**

Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates. Industrial conflict – Causes, Types, Prevention and Settlement.

Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment
Pedagogy: Chalk and talk method, Power Point Presentation

Course Outcomes: At the end of the course student will be able to

1.	Describe the basic concepts of HRM & HRP.
2.	Elucidate the HRM functions of recruitment, selections, and appraisal.
3.	Apply the training, development and compensation methods in HRD.
4.	Identify the employee grievances to spell out the remedial measures.
5.	Infer the concepts of e-HRM and I-HRM.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1501-1-1.1	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.2	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.3	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.4	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.5	3	-	-	-	-	1	-	-	1	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P Courseba Rao, "Essentials of Human Resource Management & Industrial Relations", Third Revised Edition.

REFERENCE BOOKS:

1.	John M. Ivancevich, "Human Resource Management", 10/e, McGraw Hill.
2.	Flippo, "Human Resource Management".

E Books / MOOCs/ NPTEL

1.	http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about

MANAGEMENT ACCOUNTING AND CONTROL SYSTEM

Course Code:	**MG1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Management

Course Objectives:

1.	Apply Cost Accounting concepts and techniques in the decision making process.
2.	Make decisions such as pricing, special order pricing, make-or-buy and elimination of a part of the company or replacement of equipment.
3.	Understand the relevance of different types of costs in the decision making process such as relevant costs, sunk costs or controllable costs.
4.	Understand fundamental concepts in Financial, Cost & Management Accounting.
5.	Develop analytical skills associated with the preparation and interpretation of Financial Statement

UNIT-I

Introduction to Cost and Management Accounting and Marginal Costing	**07 Hours**

Cost Accounting – Meaning, Objectives and Scope, Management Accounting – Meaning, Objectives and Scope, Tools and Techniques of Management Accounting, Relationship of Cost Accounting, Financial Accounting, Management Accounting and Financial Management, Conflicts in Profit versus Value Maximization Principle, Role of Management Accountant in Decision Making.

Marginal Costing	**08 Hours**

Meaning, Advantages, Limitations and Applications. Breakeven Analysis, Cost Volume Profit Analysis, P/V Ratio and its Significance, Margin of Safety, Absorption Costing: System of Profit

Reporting and Stock Valuation, Difference between Marginal Costing and Absorption Costing, Income Measurement under Marginal Costing and Absorption Costing. (Practical Problems)

UNIT II

Standard Costing and Budgetary Control	**07 Hours**
Standard Costing – Definition, Significance and Applications, Various Types of Standards, Installation of Standard Costing System-for Material, Labour, and Overhead. Variance Analysis for Materials, Labour and Overheads, Accounting Treatment of Variances. Benchmarking for Setting of Standards, Variance Reporting to Management. (Practical Problems)	
Budgetary Control	**08 Hours**
Budget Concept, Manual, Fixed and Flexible Budgets, Preparation and Monitoring of Various Types of Budgets, Budgetary Control System- Advantages, Limitations and Installation. Zero Base Budgeting, Programme and Performance Budgeting. (Practical Problems)	

UNIT III

Fund Flow and Cash Flow Statement	**05 Hours**
Fund Flow Statement Analysis – Definition, Features, Steps for Preparation of Fund Flow Statement.	
Cash Flow Statement Analysis	**05 Hours**
Classification, Preparation of Cash Flow Statement, Uses of Cash Flow statement, Difference between Cash Flow and Fund Flow Statement. (Practical Problems)	

Course Outcomes: At the end of the course student will be able to

1.	Describe the Cost Accounting concepts and techniques in the decision making process.
2.	Elucidate the Make decisions such as pricing, special order pricing, make-or-buy and elimination of a part of the company or replacement of equipment.
3.	Apply the relevance of different types of costs in the decision making process such as relevant costs, sunk costs or controllable costs.
4.	Identify fundamental concepts in Financial, Cost & Management Accounting.
5.	Infer the analytical skills associated with the preparation and interpretation of Financial Statement

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1502-1-1.1	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.2	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.3	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.4	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.5	3	-	-	-	-	1	-	-	1	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	M.Y. Khan and P.K. Jain. “Management Accounting”, McGraw-Hill Education
2.	Robert N. Anthony, “Management Accounting”, Richard Dirwin.
3.	I.M. Pandey , “Management Accounting”, Vikas Publishing House.
4.	Paresh shaw, “Management Accounting”, Oxford University Press.
5.	A. Murthy and S. Gurusamy , “Management Accounting”, McGraw Hill.
6.	NM Singhvi and Ruzbeh J. Bodhanwala, “Management Accounting”, PHI learning Pvt. Ltd.

OPERATIONS AND QUALITY MANAGEMENT

Course Code:	**MG1503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Management

Course Objectives:

1.	Define production/operations management. Differentiate between Production and service system and types of production systems Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
2.	Solve problems on fundamentals of statistics and normal distribution. Draw and Analyze variable process control charts and determine process capability.
3.	Discuss Total Quality Management tools and methods. Calculate reliability of series and parallel systems using the information on failure rate and time.
4.	Solve decision-making problems using break even analysis and decision tree methods. Apply the concepts of Design and System capacity. Solve problems on faculty location using break even analysis and transportation method. Solve problems related to product and process layouts.
5.	Use concepts of replacement theory to solve problems of replacing items that fail gradually and suddenly.

UNIT-I

Production and Operations Management	**06 Hours**

Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity, Introduction to Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

Philosophy of statistical process control and modeling process quality	**11 Hours**

Normal distribution tables, Finding the Z score, Central limit theorem, Chance and assignable causes of variation, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, warning limits)

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems,

Process capability: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT II

Quality Concepts and Reliability	**06 Hours**

Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement, Key dimensions of Quality, Concept of cost of quality. Customers' perception of quality.

TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.

Managing Quality: Quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, 7 QC tools.

Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve, Reliability of series and parallel systems, Numerical problems on the above topics.

Operations Management activities	**12 Hours**

Decision Making: The decision process, characteristics of operations decisions, use of models - decision making environments. Break even Analysis, Decision trees.

Capacity Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity. Design, System an actual capacity. System efficiency and utilization.

Determination of Equipment requirement for a single stage production processes. Numerical problems on the above.
Facilities location planning: Need for location decisions, nature of locations decisions, general procedure for making locations decisions, Use of Breakeven analysis and Transportation algorithms for making location decisions.
Facilities layout planning: Need for layout decisions. Minimizing material handling cost in process ayout using Load distance analysis, Simple line balancing problems in product layout.

UNIT III

Replacement Theory	**05 Hours**

Replacement policy for equipment which deteriorates gradually. Replacement of items that fail suddenly.
Pedagogy: Chalk and talk method, Power Point

Course Outcomes: At the end of the course student will be able to

1.	Define production/operations management. Differentiate between Production and service system and types of production systems Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
2.	Solve problems on fundamentals of statistics and normal distribution. Draw and Analyze variable process control charts and determine process capability.
3.	Discuss Total Quality Management tools and methods. Calculate reliability of series and parallel systems using the information on failure rate and time.
4.	Solve decision-making problems using break even analysis and decision tree methods. Apply the concepts of Design and System capacity. Solve problems on faculty location using break even analysis and transportation method. Solve problems related to product and process layouts.
5.	Use concepts of replacement theory to solve problems of replacing items that fail gradually and suddenly.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
MG1503-1-1.1	2	1	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.2	2	2	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.3	1	1	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.4	3	2	-	-	-	-	-	-	-	-	3	-
MG1503-1-1.5	1	1	-	-	-	-	-	-	-	-	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Joseph G Monks, "Production / Operations Management", McGraw Hill Books
2.	William J Stevenson, "Production and Operations Management", Tata McGraw Hill, 8th Edition.
3.	RC Gupta, "Statistical Quality Control", Khanna Publishers, New Delhi, 2005.
4.	N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill, 2015

REFERENCE BOOKS:

1.	E.L. Grant and R.S. Leavenworth, "Statistical Quality Control", 7th edition, McGraw- Hill publisher, 2004.
2.	Prem Kumar Gupta, D S. Hira, "Operations Research", S Chand Publications, New Delhi, 2nd edition 2008, Prentice Hall.
3.	W S Messina, "Statistical Quality Control for Manufacturing Managers", Wiley & Sons, Inc. New York, 1987

4.	Montgomery, Douglas, "Statistical Quality Control**",** 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ.
5.	Jerry Banks, "Principles of Quality Control", Wiley & Sons, Inc. New York.

ORGANIZATIONAL BEHAVIOUR

Course Code:	**MG1504-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Management

Course Objectives:

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.
5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

UNIT-I

15 Hours

Introduction: Conceptual Foundation of Organisational Behaviour; Nature and Characteristics; Determinants; Contributing Disciplines; Challenges and Opportunities for Organisational Behaviour, Models and Approaches of Organizational Behaviour, OB and Emotional Intelligence.
Perception, Attitude, and Values: Nature, Process, Importance, Factors Influencing Perception; Attribution Theory of Perception; Issues Involved in Perception: Selective Perception, Halo Effect, Contrast Effect, Projection, Stereotyping; Concept of Pygmalion Effect; an overview of Emotions and feelings, Values, Beliefs and Attitudes with Managerial Implications.
Learning: Concept; Theories of Learning: Conditioning, Social Learning, Managerial Implication of Learning Theories. Reinforcement.
Motivation: Concept, Major Theories and Process of Motivation: Maslow’s Need-Hierarchy Theory; Herzberg’s Motivation-Hygiene Theory; McGregor’s Theory X and Theory Y; Goal- Setting Theory; ERG Theory; Vroom’s Expectancy Theory; Equity Theory; Managerial implications of Various Theories.
Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

UNIT II

15 Hours

Leadership: Concept and Functions; Style and Theories of Leadership: Traits, Behavioural and Situational/ Contingency Groups of Theories; Inspirational approaches to Leadership; Charismatic Leadership, Transformational Leadership, and Transactional Leadership, Contemporary Leadership Roles; Challenges to the Leadership Construct; Substitutes and Neutralizers to Leadership.
Group Behaviour: Groups: Concept and Classification; Stages of Group Development; Group Structure; Roles and Norms; Premise and Issues; Group Decision-Making: Group vs Individual; Groupthink and Groups Shift; Group Decision Making Techniques and Process.
Conflict Management: Concept; Causes; Types; Stages; Effects; Management of Conflicts.
Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

UNIT III

10 Hours

Organizational Culture: Concept; Dominant Culture; Strong vs Weak Cultures ; Creating and Sustaining Culture; Employees Learning of The Culture; Creating a Customer-Responsive Culture.
Organizational Changes: Concept and Forces for Change; Managing Planned Changes; Resistance to Change; Approaches to Manage Organizational Change; Organizational Development; Culture-Boundedness of Managing the Change.

Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

Course Outcomes: At the end of the course student will be able to

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.
5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1504-1-1.1	2	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.2	2	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.3	1	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.4	3	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.5	1	-	-	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Robbins, SP Stephen P, Timothy Judge and Nehasika Vohra, "Organisational Behaviour", 12th or 16th edition, Pearson Education, 2011.
2.	Fred Luthans, "Organisational Behaviour", 11th edition, Mc Graw Hill, 2009.

REFERENCE BOOKS:

1.	W. Newstrom, John, "Organisational Behaviour", 10th edition, Tata Mc Graw –Hill 2009.
2.	Paul Heresy, Kenneth H. Blanchard, and Dewey E. Johnson, "Management of Organisational Behaviour", Leading Human Resources, 2008.
3.	Dr S S Khanka, "Organisational Behaviour", S. Chand & Co, New Delhi, 2008.
4.	Sanghi Seema, "Organisational Behaviour", Pearson, 2011.

TAXATION FOR ENGINEERS

Course Code:	**MG1505-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Management

Course Objectives:

1.	To make students understand the overview of Income Tax Law in India.
2.	To make students understand the basic concepts of income tax such as residential status, tax incidence.
3.	To make students understand the income tax provisions involved in determination of income from salary, House property, business and profession, capital gain and other sources.
4.	To help students understand the determination of tax liability Individual assessees.
5.	To make students understand the deductions u/s 80.

UNIT-I

Basic concepts and Explanation under various Heads of Income	**15 Hours**

Basic concepts: Assessment Year, Previous Year, Person, Assessee, Income, Charges on Income, Gross Total Income, Capital and Revenue Receipts, Residential status, Connotation of income, Deemed to accrue or arise in India, Incidence of tax, Tax Planning, Tax Evasion, Tax Management. (Problems on Residential Status of Individual assessee)

Explanation under various Heads of Income: Income from Salary (theory, basic and full-fledged problems on allowances, perquisites and retirement benefits)

UNIT II

Income under the head Profit and gains of Business or Professions and Income under Capital Gain	**15 Hours**

Income under the head Profit and gains of Business or Professions and its computation - basis - Method of accounting - Scheme of business deductions/ allowance - Deemed profits - maintenance of books, (Problems on computation of Income from Business/ Profession of Individual assessee)
Income under Capital Gain: Basis of charge, Transfer of capital asset, inclusion & exclusion from Capital Asset, Capital Gain, Computation of Capital Gains (theory & problems), Exemptions/deductions from capital gains

UNIT III

Income from House Property and Other Sources	**10 Hours**

Income from House Property - Basic problems on House Property
Income from Other Sources (theory only)
Deductions under section 80C to 80U (No problems - Provisions only)

Course Outcomes: At the end of the course student will be able to

1.	Exhibit an understanding of the Income Tax Law in India.
2.	Identify the nature of Incomes and their tax incidence.
3.	Demonstrate how to determine the income from salary, house property, business and profession, capital gain.
4.	Demonstrate the determination of tax liability of Individual assessees.
5.	Exhibit a clear understanding of various provisions of deductions u/s 80.

Course Outcomes Mapping with Program Outcomes

	Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	

↓ Course Outcomes												
MG1505-1-1.1	2	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.2	2	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.3	3	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.4	3	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.5	3	-	-	-	-	1	-	-	1	-	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Vinod Singhania, "Students Guide to Income Tax", Taxman Publications.
2.	Mehrotra & Goyal, "Direct Tax", Sahitya Bhavan.
3.	Lal & Vashisht, "Direct Tax", Pearson Ed. 28E.
4.	V S Datey, "Indirect Taxes", Taxman Publications.
5.	Vinod Singhania, "Direct Taxes", Taxman Publications.
6.	T N Manoharan, "Students Guide to Income Tax", Snow White.
7.	Kul Bushan, "How to deal with VAT", Pearson Education/PHI, 1/e.
8.	Mahesh Chandra & Shukla , "Income Tax Law & Practice", Pragathi Publications.
9.	Dr.Pillai, "VAT", Jaico Publications.

WORKING CAPITAL MANAGEMENT

Course Code:	**MG1506-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Need of the Course: The course will enable the student to manage activities in the area of working capital in an enterprise and help the students to do advance study in the field of financial-management through detailed analysis of financial statements, liquidity crises, cash optimization, credit analysis etc. The student will learn how to apply sound techniques for managing inventory.

Description of the Course: Every business needs adequate liquid resources in order to maintain day-to-day cash flow. It needs enough cash to pay wages and salaries as they fall due and to pay creditors if it is to keep its workforce and ensure its supplies. Maintaining adequate working capital is not just important in the short-term. Sufficient liquidity must be maintained in order to ensure the survival of the business in the long-term as well. Even a profitable business may fail if it doesn't have adequate cash flow to meet its liabilities as they fall due.

Teaching Department: Management

Course Objectives:

1.	Discuss the importance of working capital management.
2.	Evaluate working capital requirement.
3.	Assess the challenges faced in managing working capital in domestic and international operations.
4.	Plan for financing working capital requirement.

UNIT-I

Working Capital Decisions, Working Capital Management and Sources of Working Capital	**15 Hours**

Working Capital Decisions: Meaning, Concepts, components Importance & types of working Capital.
Working Capital Management: Meaning, objectives, Principles, Importance of adequate working capital & consequences of inadequate working capital, Dangers of excessive working capital, determinants of working capital - operating cycle and Cash cycle. Approaches to determine an appropriate financing mix, Estimation of working capital requirements (problems) important working capital ratios.
Sources of Working Capital: Financing of long term working capital & short term working capital. Factoring - Meaning mechanism, Functions, types, merits & demerits.

UNIT II

Liquidity Management and Receivable Management	**15 Hours**

Liquidity Management: Cash Management - Meaning - Objectives of Cash Management - Nature of Cash - Motives of holding cash - Cash Management planning aspects - Cash Budgets (Problems), Cash Management control aspects - Concentration banking - Lock box system - Playing the float - Cash Management models - William J Baumol Model - Miller-Orr Model (Problems using these models)

Receivable Management: Definition, Objectives, cost and benefits of receivable. Credit policy & its variables. Types of Credit policy & their merits & demerits, Factors influencing the size of investment in receivables. Control of receivables. Framing optimum credit policy & Average collection period (Problems)

UNIT III

Inventory Management	**10 Hours**
Meaning of Inventory - Need/Purpose of holding inventory - Benefits of holding inventory - Risk and cost of holding inventory - Management of Inventory - Objectives of Inventory Management - Techniques of Inventory Management - Economic Order Quantity (EOQ) - Determination of Stock levels - ABC analysis - Just in Time (JIT).	

Course Outcomes: At the end of the course student will be able to

1.	Understand the meaning of working capital
2.	Realize the importance of management of working capital in an organization
3.	Learn about some key liquidity ratios used to understand more about a business' working capital position
4.	Understand various techniques used to manage working capital.
5.	Be aware of the techniques of cash, inventory and receivables management.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1506-1-1.1	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.2	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.3	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.4	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.5	2	-	-	-	-	1	-	-	-	1	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Sekhar Satya G.V., "Working Capital Management", 1/e; New Delhi: Wiley, 2014.
2.	Bhalla V. K., "Working Capital Management", 1/e; New Delhi: S. Chand Publishing, 2014.
3.	Sagner James S., "Working Capital Management, Applications and Cases", 1/e, New Delhi: Wiley, 2015.

NANOTECHNOLOGY

Course Code:	**PH2501 -1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**PH1001 -1**		

Teaching Department: PHYSICS

Course Objectives:

1.	To understand the basic scientific concepts of nanoscience, properties of nano materials, synthesis and fabrication of nano materials.
2.	To understand the various characterization techniques of nano materials.
3.	Study of carbon nano technology and its characterizations.
4.	To understand the applications of nano technology in various science, engineering and technology fields.

UNIT-I

Properties of Materials	**07 Hours**
Introduction: History of nano science, definition of nano meter, nanomaterials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes, Band structure.	

Properties Of Materials: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Synthesis and Fabrication	**08 Hours**

Synthesis of bulk polycrystalline samples, growth of single crystals, Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography, Requirements for realizing semiconductor nano structure, growth techniques for nano structures.

UNIT-II

Characterization Techniques	**15 Hours**

X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy (TEM), scanning probe microscopy (SEM), atomic force microscopy (AFM), piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, UV-VIS-IR Spectrophotometers, Magnetic and electrical measurements and Infrared/ Raman, EPR and NMR

UNIT-III

Carbon Nano Technology	**05 Hours**

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, and applications of carbon nano tubes.

Applications of Nano Technology	**05 Hours**

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin films, applications of quantum dots.

Course Outcomes: At the end of the course student will be able to

1.	Ability to choose the appropriate nano material to meet the requirerment of a particular application.
2.	Identify the essential concepts used in nanotechnology.
3.	Identify the materials, properties, synthesis and fabrication of nanomaterials.
4.	Understand the various characterization techniques of nano materials.
5.	Applications of nanomaterials in various fields

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
PH2501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.2	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.3	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.4	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.5	3	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	M.S. Ramachandra Rao, Shubra Singh, "Nano science and nano technology", Wiley publishers.

REFERENCE BOOKS:

1.	Charles P. Poole, Jr. Frank J. Owens, "Introduction to Nano Technology", Wiley publishers.

2.	Jermy J Ramsden, "Nanotechnology", Elsevier publishers.
3.	A. K. Bandyopadhyay, "Nano Materials", New Age publishers.
4.	T. Pradeep, "Nano Essentials", TMH.
5.	M. A. Shah, "Nanotechnology the Science of Small", Wiley publishers.
6.	Phani Kumar, "Principles of Nanotechnology", Scitech.
E Books / MOOCs/ NPTEL	
1.	https://youtu.be/ebO38bbq0_4
2.	https://youtu.be/0MzIh7wkgMs

OPTOELECTRONIC DEVICES

Course Code:	**PH2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**PH1001 -1**		

Teaching Department: PHYSICS

Course Objectives:

1.	To understand the basic principles of construction, working and applications of various optoelectronic devices.
2.	Study of sources of radiation like lasers and LED, their specific properties and hence their use for applications.
3.	Study of radiation detectors like semiconductor detector, diode as detector and photo multiplier.
4.	Understanding the fabrication and applications of optical fibers, optical modulators and waveguides for optical communication

UNIT-I

Optical processes in Semiconductor, Display devices & Optical fibers	**15 Hours**

Elements of optical phenomena in Semiconductors- fundamentals of Fermi-Dirac distribution, band structure, direct and indirect band gap semiconductors, generation-recombination mechanisms, absorption and emission processes.
Display devices- cathode ray tube, liquid crystal display, charge coupled devices, plasma display.
Optical fibers- types of fibers, modes of propagation, attenuation and losses, optical fiber communication system, advantages.

UNIT-II

Optical Sources and Detectors	**15 Hours**

Lasers- basic principles, optical resonator-types, modes and quality factor, practical lasers- Nd-YAG, CO2, Excimer laser, Semiconductor laser- basic structure, laser action, heterojunction laser, quantum well laser, applications.
Light emitting diode- electroluminescence in p-n junction, LED characteristics, efficiency and responsivity, Heterojunction LED, Surface-Emitting LED and Edge emitting LED.
Photo detectors- photo conductor detector, junction photo diode, p-i-n photo diode, avalanche photo diode. Photo multiplier tube.

UNIT-III

Integrated Optics and Modulators	**10 Hours**

Modulation of light- Analog and digital modulation, Direct modulation - using LED and Semiconductor diode laser (SDL). External modulation - Electro-optic modulators (Pockels effect), Electro-absorption modulators. Acousto-optic modulation. Waveguides- device structure, waveguide devices – waveguide lenses, light bending devices, optical power dividers, directional couplers, waveguide polarizer, wavelength multiplexers and demultiplexers. Waveguide coupling. Optoelectronic integrated circuit

Course Outcomes: At the end of the course student will be able to

1.	Ability to choose the appropriate device to meet the requirement of a particular application.
2.	Making modifications to device structures by understanding the factors affecting their performance.
3.	Attempting better efficiency and utility through an understanding of the principles of performance.
4.	Use the technical knowledge acquired to troubleshoot and rectify devices and circuits.

5.	Explore the possibility of designing devices with better characteristics.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
PH2502-1.1	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.2	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.3	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.4	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.5	3	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P.R.Sasikumar, "Photonics – an introduction", PHI Learning Pvt. Ltd.,New Delhi, 2012 edition.
2.	Pallab Bhattacharya, “Semiconductor Opto Electronic Devices”, Prentice Hall of India Pvt., Ltd., New Delhi, 2006.

REFERENCE BOOKS:

1.	J.Wilson and J.Haukes, "Opto electronics- an introduction", Prentice Hall of India, New Delhi.
2.	Jasprit Singh, ‘"Opto electronics- an introduction to Materials and Devices", McGraw Hill international ed., 1998.
3.	A.Ghatak and Thyagarajan, "Introduction to opto electronics", New Age International Publication.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/115102026/

AUTONOMOUS MOBILE ROBOTS

Course Code:	**RI2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC 1001-1, ME 1003-1**		

Teaching Department: Robotics and Artificial Intelligence

Course Objectives:

1.	Explain different types of locomotion in mobile robots to obtain a required task.
2.	Understand the different types of kinematics and dynamics involved in a mobile robot.
3.	Study the different types of sensors used in an autonomous mobile robot.
4.	Understand the different types of algorithms to identify the position of the mobile robot.
5.	Understand the various algorithms for planning and navigation of the mobile robot.

UNIT-I

Robot locomotion	**07 Hours**
Types of locomotion, hopping robots, legged robots, wheeled robots, stability, maneuverability, and controllability.	
Mobile robot kinematics and dynamics	**09 Hours**
Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots.	

UNIT-II

Perception	**07 Hours**
Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision-based sensors, uncertainty in sensing, filtering.	
Localization	**07 Hours**
Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, and positioning beacon systems.	

UNIT-III

Introduction to planning and navigation	**10 Hours**
Path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP).	

Course Outcomes: At the end of the course student will be able to

1.	Explain different types of locomotion in mobile robots to obtain a required task.
2.	Identify the different types of kinematics and dynamics involved in a mobile robot.
3.	Apply the different types of sensors used in an autonomous mobile robot.
4.	Apply the different types of algorithms to identify the position of the mobile robot.
5.	Apply the various algorithms for planning and navigation of the mobile robot to reach the destination.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
RI2501-1.1	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.2	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.3	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.4	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.5	3	3	3	3	2	1	-	-	-	-	-	3

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	R. Siegwart, I. R. Nourbakhsh, “Introduction to Autonomous Mobile Robots”, The MIT Press, 2011.
2.	Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Springer Tracts in Advanced Robotics, 2011.
3.	S. M. LaValle, “Planning Algorithms”, Cambridge University Press, 2006. (Available online http://planning.cs.uiuc.edu/)
REFERENCE BOOKS:	
1.	Thrun, S., Burgard, W., and Fox, D., "Probabilistic Robotics". MIT Press, Cambridge, MA, 2005.
2.	Melgar, E. R., Diez, C. C., "Arduino, and Kinect Projects: Design, Build, Blow Their Minds", 2012.
3.	H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementations", PHI Ltd., 2005.
E Books / MOOCs/ NPTEL	
1.	https://archive.nptel.ac.in/courses/112/106/112106298/
2.	https://www.edx.org/course/autonomous-mobile-robots

MEDICAL ROBOTICS
(For All except AI)

Course Code:	**RI2502-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**PH 1001-1, IS 1001-1, CY 1001-1**		

Teaching Department: Robotics and Artificial Intelligence

Course Objectives:

1.	Understand the types of medical robots used in the field of healthcare.
2.	Explain the various localization and tracking sensors
3.	Understand the applications of surgical robots with the help of few case studies
4.	Understand Rehabilitation of limbs and brain machine interface with the help of few case studies
5.	Understand the design methodology of medical robots.

UNIT-I

Introduction — **07 Hours**

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare. Localization And Tracking

Position sensors requirements — **09 Hours**

Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic -Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking

UNIT-II

Control Modes Radiosurgery — **07 Hours**

Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies.

Rehabilitation — **07 Hours**

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles – case studies.

UNIT-III

Design of Medical Robots — **10 Hours**

Characterization of gestures to the design of robots- Design methodologies- Technological choices - Security

Course Outcomes: At the end of the course student will be able to

1.	Describe the types of medical robots and the concepts of navigation and motion replication.
2.	Describe about the sensors used for localization and tracking
3.	Explain the applications of surgical robots
4.	Explain the concepts in Rehabilitation of limbs and brain machine interface
5.	Classify the types of assistive robots and analyze the design characteristics, methodology and technological choices for medical robots.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
RI2502-1.1	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.2	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.3	3	-	1	-	-	-	-	-	-	-	-	1

RI2502-1.4	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.5	3	-	3	-	-	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modeling and Control", Wiley Publishers, 2006.
2.	Paula Gomes, "Medical robotics- Minimally, Invasive surgery", Woodhead, 2012.
3.	Achim Schweikard, Floris Ernst, "Medical Robotics", Springer, 2015.

REFERENCE BOOKS:

1.	Jocelyne Troccaz, "Medical Robotics", Wiley-ISTE, 2012.
2.	Vanja Bonzovic, "Medical Robotics", I-tech Education publishing Austria, 2008.
3.	Daniel Faust, "Medical Robotics", Rosen Publishers, 2016.
4.	Jocelyne Troccaz, "Medical Robotics", Wiley, 2013.

E Books / MOOCs/ NPTEL

1.	https://www.futurelearn.com/courses/medtech-ai-and-medical-robots
2.	https://web.stanford.edu/class/me328/

PLC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS

(For All except AI)

Course Code:	**RI2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE 1001-1, EC 1001-1**		

Teaching Department: Robotics and Artificial Intelligence

Course Objectives:

1.	To understand the fundamentals of fluid power transmission systems
2.	To design various hydraulic system components.
3.	To design various pneumatic system components.
4.	Learn various types of hydraulic and pneumatic power circuits.
5.	Learn various types of applications in fluid power circuits using PLC.

UNIT-I

Fluid power systems and fundamentals	**06 Hours**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, General types of fluids - Properties of hydraulic fluids -Fluid power symbols. Basics of Hydraulics-Applications of Pascal's Law

Hydraulic system components	**05 Hours**

Sources of Hydraulic Power: Pumping theory - Pump classification - construction and working of pumps - Variable displacement pumps, pump performance. Actuators: Linear hydraulic actuators-Single acting and double acting cylinders, Rotary actuators - Fluid motors.

Control Components	**04 Hours**

Direction control valve - Valve terminology - Various center positions. Shuttle valve - check valve - pressure control valve - pressure reducing valve, sequence valve. Flow control valves - Fixed and adjustable Safety valves.

UNIT-II

Pneumatic system components	**07 Hours**

Pneumatic Components: Properties of air. Compressors. FRL Unit -Air control valves, Quick exhaust valves and pneumatic actuators- cylinders, air motors. Basics of low-cost automation

Fluidics & Pneumatic circuit design	**08 Hours**

Fluidics - Introduction to fluidic devices, simple circuits. Introduction to Electrohydraulic Pneumatic logic circuits, PLC applications in fluid power control, Sequential circuit design for simple applications using classic, cascade, logic with Karnaugh- Veitch Mapping and combinational circuit design methods.

UNIT-III

Fluid power circuits	**10 Hours**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

Course Outcomes: At the end of the course student will be able to

1.	Compare the basics of hydraulics to the performance of fluid power systems
2.	Explain the working principle of hydraulic systems including pumps and control components.
3.	Explain the working principle of pneumatic systems and their components.
4.	Design various types of Electrohydraulic and electro pneumatic circuits
5.	Design various types of applications in fluid power circuits using PLC.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
RI2503-1.1	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.2	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.3	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.4	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.5	3	2	3	2	3	-	-	-	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 2008.
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2009.

REFERENCE BOOKS:

1. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
2. Harry L. Stevart D. B, "Practical guide to fluid power", Taraoeala sons and Port Ltd.Broadey, 2010.
3. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 2011.
4. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 2011.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/108/105/108105088/
2. https://plc-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/COEP_KNOWLEDGE_SEEKERS/labs/exp1/theory.html

ENGINEERING MATHEMATICS I

Course Code:	MA1009-1	Credits:	04

Course Objectives:

1.	To build strong foundation in differential calculus to solve engineering problems.

Syllabus:	52 Hours

Definition of the limit and its calculation, continuity, limits involving infinity.

Tangent lines, rates of change and derivatives, derivative function, basic rules of differentiation, product rule, quotient rule and chain rule, implicit differentiation, total differentiation, related rates, differentials and linear approximations.

Exponential functions, inverse functions and logarithms, derivatives of exponentials and logarithms, inverse trigonometric functions, indeterminate forms.

Taylor's theorem for a function of one and two variables, maximum and minimum values, mean value theorem, increasing and decreasing functions critical numbers, concavity, inflection points, first and second derivative tests, curve tracing, optimization problems, anti derivatives.

Definite integrals, evaluation of definite integrals, Fundamental theorem of calculus, integration using substitution rule. Application of integration to find distances and areas.

TEXTBOOKS:

1.	Essential calculus; Early transcendentals: James Stewart (2007), Thomson Brooks/Cole, ISBN-13:978-0-495-01428-7

ENGINEERING CHEMISTRY

Course Code:	CY1001-1	Credits:	03

Course Objectives:

1.	a) Know the basics of electrochemistry and its usage in the working of fuel cells and modern-day batteries. b) Gain knowledge of the harmful effects of corrosion on metal and techniques used in preventing it, including metal finishing.
2.	a) Get acquainted with the different types of industrially important polymers along with their characteristic properties. b) Know the requirements of boiler feed water.
3.	a) Get the knowledge on the different chemical fuels and related parameters. b) Know the basics of liquid crystals. c) Understand the different routes of nonmaterial synthesis.
4.	To provide students with practical knowledge of quantitative analysis of materials by classical methods.
5.	Familiarize with the practical knowledge of chemistry enabling their skill development by instrumental methods of analysis.

UNIT-I

Electrochemical Cells & Battery Technology — **8 Hours**

Introduction, Derivation of Nernst equation for single electrode potential. EMF of the cell, Numerical problems. Construction and working of calomel electrode, Measurement of single electrode potential. Ion-selective electrode- definition, construction, and working of the glass electrode. Determination of pH using a glass electrode.

Introduction to battery, battery characteristics, Classification of batteries–primary, secondary, and reserve batteries. Construction, working, and applications of Lithium-ion battery, and Flow batteries- Construction, working and applications of Vanadium flow battery. Fuel cells- Introduction, construction, working, and uses of Methanol-Oxygen fuel cells.

Corrosion Science & Metal Finishing — **7 Hours**

Corrosion - definition, Electro-chemical theory of corrosion, Factors affecting the rate of corrosion. Differential metal corrosion- galvanic series, Differential aeration corrosion - Waterline and pitting corrosion. Stress corrosion. Corrosion Control: Protective coatings; Inorganic coating - Anodizing and Phosphating. Metal coating - Galvanization and Tinning, cathodic protection.

Introduction to metal finishing, Polarization, decomposition potential, and over-voltage.

Electroplating, effect of plating variables on the nature of electrodeposit, Electroplating of Chromium, Electroless plating - advantages, Electroless plating of copper on PCB.

UNIT-II

Polymers — **7 Hours**

Definition, Classification, free radical mechanism of polymerization of vinyl chloride. Emulsion polymerization. Glass transition temperature. Structure and property relationship.

Synthesis, properties, and applications of PMMA, Polycarbonate

Elastomers – Definition, Synthesis, and applications of Butyl rubber and Silicone rubbers.

Adhesives- Synthesis and applications of Epoxy resins. Polymer Composites: Introduction, synthesis, properties, and applications of carbon fiber. Conducting polymers-definition, applications. Mechanism of conduction in polyacetylene.	
Water Chemistry	**6 Hours**
Impurities in water, Water analysis - Determination of Hardness, determination of Dissolved Oxygen by Winkler's method, Boiler feed water, and boiler problems – scales and sludges, boiler corrosion. External treatment - hot lime soda process, Ion-exchange method. Internal treatment -phosphate conditioning, colloidal conditioning, Calgon conditioning. Desalination of seawater - Electro dialysis and reverse osmosis. Sewage treatment: Primary, secondary, and tertiary treatment.	
Nanomaterials	**2 Hours**
Introduction, classification of nanomaterials. Synthesis of nanomaterials by microwave, combustion, chemical vapour deposition, and sol-gel methods. Applications of nanomaterials.	
UNIT-III	
Chemical Fuels	**6 Hours**
Introduction, definition, classification of fuels. Calorific value-definition, Gross, and Net calorific values. Determination of calorific value of a solid/liquid fuel using a Bomb calorimeter. Numerical problems. Petroleum cracking-fluidized bed catalytic cracking. Reformation of petrol. Knocking and its harmful effects. Prevention of knocking, power alcohol and biodiesel.	
Liquid Crystals	**4 Hours**
Introduction, classification- Thermotropic, and Lyotropic with examples. Types of mesophases - nematic, chiral nematic, smectic, and columnar. The chemical constitution of liquid crystals. Electro-optic effect of liquid crystals. Applications of liquid crystals in display systems.	

TEXTBOOKS:	
1.	Engineering Chemistry by P.C. Jain & Monica Jain., DhanpatRai Publications, New Delhi,2015.
2.	Engineering chemistry by R V Gadag & A Nityananda Shetty., IK International Publishing House Private Ltd. New Delh,2016.
3.	Physical Chemistry, by P. W. Atkins, Oxford Publications. (Eighth edition-2006).
REFERENCE BOOKS:	
1.	Chemistry for Engineering Students by B.S. Jai Prakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar., Subhash Publications, Bangalore.2016.
2.	Principles of Physical Chemistry by B.R.Puri, L.R.Sharma& M.S. Pathania., S.Chand& Co. Pvt. Ltd. NewDelhi.1998.
3.	Liquid crystals and plastic crystals, Vol-I, edited by G.W.Gray and P.A.Winsor, Ellis Horwood Series in Physical Chemistry, New York. 2010, (p.No.106-142).
4.	Corrosion Engineering by M.G.Fontana, Mc Graw HillPublications.2006.
5.	Vogel's textbook of quantitative inorganic analysis, revised by J.Bassett, R.C. Denny, G.H. Jeffery, 4thEd.
6.	Laboratory manual in Engineering Chemistry Sudharani, Dhanpatrai Publishing Company, New Delhi.
E Books / MOOCs/ NPTEL	
1.	*http://bcs.whfreeman.com/vollhardtschore5e/default.asp.*
2.	*https://www.ttu.ee/public/m/Mehaanikateaduskond/Instituudid/Materjalitehnika_instituut/MTX9100/Lecture11_Synthesis.pdf.*

3.	*http://nptel.ac.in/courses/113108051/module1/lecture1.pdf*

ENGINEERING CHEMISTRY LAB			
Course Code:	**CY1001-1**	**Credits:**	**01**

List of Experiments

1.	Determination of Total Hardness of a sample of water using disodium salt of EDTA.
2.	Determination of percentage of copper in brass using standard sodium thiosulphate solution.
3.	Determination of nitrogen ammonia in each sample of fertilizer using a standard hydrochloric acid solution.
4.	Determination of manganese dioxide in Pyrolusite using standard potassium permanganate solution.
5.	Determination of Iron in the given sample of Hematite ore solution using potassium dichromate crystals by external indicator method.
6.	Determination of Chemical Oxygen Demand (COD) of the given industrial waste Water sample.
7.	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$solution.
8.	Colorimetric determination of iron.
9.	Conductometric estimation of an Acid mixture using standard NaOH solution.
10.	Determination of pKa of a weak acid using pH meter.
11.	Determination of the viscosity coefficient of a given liquid using Ostwald's viscometer.
12.	Flame photometric estimation of sodium in the given sample of water.

ELEMENTS OF CIVIL ENGINEERING AND ENGINEERING MECHANICS

Course Code:	**CV1003-1**	**Credits**	**04**

Course Objectives:

1.	Solve the engineering problems in case of equilibrium conditions
2.	Calculate the reaction forces of various supports of different structures
3.	Solve the problems involving dry friction
4.	Determine the centroid, center of gravity and moment of inertia of various surfaces and solids
5.	Explain the concepts of work-energy method and its applications to translation and plane motion.

UNIT-I

09 Hours

Scope and importance of different fields of Civil Engineering.
Introduction to Engineering Mechanics: Basic idealizations - Definition of force, Characteristics of a force, Force systems and classification; Axioms of Mechanics. Concept of free body diagram.
Resolution of forces, Composition of forces - Definition of Resultant; Resultant of coplanar concurrent force system.

UNIT-II

11 Hours

Moment of a force, couple, characteristics of couple, Equivalent force - couple system;
Varignon's theorem, Resultant of coplanar - non-concurrent force system.
Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems. Equilibrium of coplanar concurrent force system.

UNIT-III

10 Hours

Equilibrium of coplanar non concurrent force systems: Simple, Hinged and fixed supports, Point, udl and uvl loads, support reactions for statically determinate beams.
Friction - Types of friction, Laws of dry friction, Limiting friction, Angle of friction, angle of repose, Ladder friction.

UNIT-IV

10 Hours

Centroid of plane figures; Locating the centroid of rectangular, triangular, semicircular, quarter of a circular area and sector of a circular areas using method of integration, Centroid of simple built up sections.
Moment of inertia of an area, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangular, triangular, semicircular and quarter of a circular area from the method of integration; Moment of inertia of composite areas.

UNIT-V

12 Hours

Kinetics of rigid bodies, Dynamic equilibrium, D'Alembert's principle, Work-energy and Impulse momentum principle, Impact of elastic bodies (direct central impact).

TEXTBOOKS:

1.	Ferdinand L. Singer "*Engineering Mechanics*"
2.	Bhavikatti,J.L, "*Engineering Mechanics*", S.S., Vikas Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:	
1.	Ferdinand P. Beer and E. Russel Johnson, "Mechanics for Engineers: Statics and dynamics" McGraw-Hill Book Company, New York.
2.	Timoshenko and Young, "Engineering Mechanics" McGraw-Hill Book Company, New Delhi.
3.	Merium J.L, Kraige L.G, Engineering Mechanics Vol.I & II Wiley Publishers.
4.	McLEAN and Nelson, "Engineering Mechanics" (Schaum's outline Series), McGraw-Hill Book Company, New Delhi.

COMPUTER AIDED ENGINEERING GRAPHICS & PRACTICE

Course Code:	**ME1008-1**	**Credits**	**03**

Objectives

1.To impart and inculcate understanding of the theory of projection and concepts like dimensioning, conventions and projection of points and lines in different quadrants of projection system.

2.To know and understand the projection of different plane surfaces.

3.To impart the knowledge on understanding and drawing of different solid objects in different positions.

4.To develop the lateral surfaces of solid objects and its use in sheet metal development

UNIT-I

Orthographic Projection	**10 Hours**

Orthographic Projection: Planes of Projection, First angle projection, reference line. Conventions employed for drawing, Projection of points located in first, second, third and fourth quadrants, Projection of Lines (First angle projection only), True and apparent lengths, true and apparent inclinations.

UNIT-II

Projection of Plane surfaces	**12 Hours**

Projection of plane surface: Triangle, Square, Rectangle, Pentagon, Hexagon and Circle in different positions.

UNIT-III

Projection of Solids	**16 Hours**

Projection of right regular solids: Prisms, Pyramids, Cones, and Cylinders in different positions.

UNIT-IV

Development of Lateral surfaces of solids	**12 Hours**

Development of lateral surfaces of: Right regular Prisms, Pyramids, Cylinders and cones and their frustums.

Isometric projection and Isometric view	**10 Hours**

Isometric scale, Difference between Isometric projection, and isometric view: To draw Isometric views of simple solids and machine components using their orthographic projections.

TEXTBOOKS:

1.	Engineering Drawing by N. D. Bhat & V. M. Panchal, Pramod R. Ingle, 53 Ed., Charotar Publishing House, Gujarat, 2014.
2.	Engineering Drawing by K R Gopalakrishna, Subhas publishers, Bangalore, 32nd edition, 2012.

REFERENCE BOOKS:

1.	A Text book of Engineering Graphics and Drafting by P. S. GILL, 11th Ed.2009, S. K. Kataria & sons, ISBN- 8185749612, 9788185749617, New Delhi.
2.	A Text book of Engineering Drawing by K. L. Narayanan & Kannaiah P, Radiant Publishing House, 9th Edition, 2012.
3.	A Primer on computer aided Engineering Drawing, Published by VTU, Belgaum, 8th edition, 2011.
4.	Engineering Drawing and Computer Graphics, Shah, Pearson, 2010.
5.	Textbook on Engineering Drawing, Narayana, Scitech Publishers, 1 December 2011
6.	Engineering Graphics, Agarwal & Agarwal, TMH, Second edition, 2013

7.	Publications of Bureau of Indian Standards a) IS 10711 – 2001: Technical products documentation – Size and lay out of drawing sheets. b) IS 9609 (Parts 0 & 1) – 2001: Technical products documentation – Lettering. c) IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings. d) IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings. e) IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

ENGINEERING MATHEMATICS II

Course Code:	MA1010 -1	Credits:	04

Course Objectives:

1. To build strong foundation in differential and integral calculus. To equip the students with the tools of mathematics so that they can solve their engineering problems.

UNIT-I	20 Hours

Derivatives of inverse trigonometric functions, Fundamental theorem of Calculus, Integration by parts, by substitution, by partial fractions, by trigonometric substitutions. Improper integrals.
Arc length, area, volume.

Sequences, Series – integral and comparison test, Cauchy's root test, D'alembert's ratio test. Power series, representing functions as power series, Taylor and McLaren's series, Application of Taylor's formula.
Calculus with parametric curves, polar co-ordinates, polar curves, lengths and areas of polar curves,

TEXTBOOKS:

1. Essential calculus; Early transcendentals: James Stewart (2007), Thomson Brooks/Cole, ISBN-13:978-0-495-01428-7.

ENGINEERING PHYSICS

Course Code:	**PH1001-1**	**Credits:**	**04**

Course Objectives:

1.	To introduce the concepts of wave mechanics to study the properties of sub-atomic particles.
2.	To study the concepts of crystalline solids and X-rays.
3.	To explain the concepts of semiconductors and semiconductor devices
4.	To explain the properties of superconductors and their applications.
5.	To explain the principle, working and applications of lasers & optical fibers.

UNIT-I

Wave mechanics — **08 Hours**

Introduction to wave mechanics. Matter waves – de Broglie's relation, characteristics of matter waves. Wave function, properties and physical significance of a wave function, probability density and normalization of wave function, Schrödinger wave equation (time dependent & independent). Application of Schrödinger wave equation –particle in a potential well of infinite depth, Eigen functions, probability densities and energy Eigen values for a particle in an infinite potential well. Numerical examples.

Crystallography & X-rays — **07 Hours**

Crystallography: Introduction to crystallography - space lattice, unit cell, primitive cell, lattice parameters. Crystal systems and Bravais lattice. Direction and planes in a crystal, Miller indices – method of finding the Miller indices. Interplanar spacing – derivation. Co-ordination number, number of atoms per unit cell and atomic packing factor - simple cubic, body centered cubic, and face centered cubic lattices.

X rays: X-rays – generation and properties. Continuous and characteristic X-rays. Bragg's law and Bragg's spectrometer, Applications. Numerical examples.

UNIT-II

Semiconductors — **11 Hours**

Semiconductors: Band structure - classification of solids. Semiconductors - intrinsic and extrinsic semiconductors, carrier generation. Direct and indirect band gap semiconductors. Fermi - Dirac Statistics, Fermi factor, Fermi energy level in intrinsic and extrinsic semiconductors and effect of temperature on Fermi level, intrinsic effect - maximum device temperature. Conductivity of intrinsic and extrinsic semiconductors - derivation. Effect of temperature on conductivity of intrinsic and extrinsic semiconductor. Hall effect - derivation of Hall coefficient, carrier concentration and mobility. Applications of Hall effect. Numerical examples.

Semiconductor devices: light emitting diode, photodiode, and solar cell.

Superconductors — **04 Hours**

Introduction to superconductors, characteristic properties. Type-I and Type-II superconductors. BCS theory (qualitative). Applications of superconductors. Numerical examples.

UNIT-III

Lasers — **05 Hours**

Lasers: Introduction to lasers. Absorption and emission of radiation, Einstein's coefficients. Condition for laser action, population inversion and metastable states. Requisites of a laser system – active medium, pumping mechanism and optical resonant cavity. Three level and four level lasers. Principle, construction and working of Nd:YAG laser, He-Ne laser and semiconductor laser. Applications.

Optical fibers	**05 Hours**

Optical fibers: Introduction to optical fibers. Propagation mechanism in optical fibers - angle of acceptance, acceptance cone and numerical aperture – derivation. Fractional index change and V-number. Types of optical fibers and modes of propagation. Attenuation. Applications. Numerical examples.

Suggested List of Experiments (Any 10 Experiments)

1.	Energy band gap of a semiconductor by four-probe technique.
2.	Hall effect – Determination of the carrier concentration in a semiconductor
3.	Transistor characteristics – Common emitter mode.
4.	Semiconductor laser - Determination of wavelength by diffraction.
5.	Zener diode characteristics – study of current-voltage characteristics
6.	Solar cell – study of its characteristics.
7.	Photo electric effect – Determination of the work function of the material of the emitter of a photocell.
8.	Charging and discharging of a capacitor – Determination of capacitance value, half time and time constant.
9.	Velocity of ultrasonic waves using ultrasonic interferometer
10.	Series and parallel resonance circuits.
11.	LED characteristics.

Course Outcomes: At the end of the course student will be able to

1.	Comprehend various properties of sub-atomic particles on the basis of wave mechanics.
2.	Understand the concepts of crystalline solids, and X-rays.
3.	Understand the concepts of semiconductors and working of semiconductor devices.
4.	Understand the characteristics of superconductors and its applications.
5.	Understand the principle, working and applications of lasers & optical fibers.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
PH1001-1.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1001-1.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	G.K.Shivakumar, Engineering Physics, Prism Engineering Education Series, Prism books Pvt Ltd., Bangalore, 2010-11 edition (Reprint 2013-14).
2.	S. P. Basavaraju, Engineering Physics, Subhas Stores, Bangalore, latest editions.
3.	Arthur Beiser et.al., Concepts of Modern Physics, Tata McGraaw Hill Education Private Limited, Special Indian Edition, 2009.

REFERENCE BOOKS:	
1.	V. Rajendran, Engineering Physics, Tata McGraw Hill Pub., 2011.
2.	M. R. Srinivasan, Physics for Engineers, New Age International Publishers, Bangalore, 2^{nd} Edition, 2009.
3.	Kenneth Krane, Modern Physics, Wiley International, 3^{rd} Edition, 2012.
4.	S. O. Pillai, Solid State Physics, New Age International, 7^{th}Edition, 2015
5.	A.Ghatak, Optics, Tata McGraw Hill Pub.,5^{th} edition, 2012
6.	A. J. Dekker, Electrical Engineering Materials, Prentice Hall India Pub., New Delhi, Reprint 2011.
7.	B. G. Streetmann, Solid State Electronic devices, 6^{th} edition, Prentice Hall India Learning Private Limited.
E BOOKS / MOOCS/ NPTEL	
1.	*http://nptel.ac.in/courses/122101002/23*
2.	*http://nptel.ac.in/courses/113106039/1*
3.	*http://nptel.ac.in/courses/115106061/*

INDIAN CULTURE-YAKSHAGANA			
Course Code:	**HU1509-1**	**Credits**	**03**
UNIT-I			**40 Hours**

- Introduction: The first step deals with a brief introduction of the Thenku Thittu Yakshagana and the differences between Thenku and Badagu Thittu.
- Basic movement: The next step is to teach the basic movements of Thenku Thittu Yakshagana.
- Pravesha: The entry of different characters will be different and there are several variations in the entries. This will be taught to students.
- Performance: The final part of the course is the performance. A Prasanga will be chosen and taught to the participants and they will perform the same in front of a live audience.

Course Activities

Class - 1st , 2nd : Thenku Thitttu Yakshagana - An Introduction
Class - 3rd : Dhingina
Class - 4th : Revision
Class - 5th : Dhingina, kitataka, tarikita kitataka
Class - 6th and 7th: Practice
Class - 8th : Dhingina, kitataka front and back+turning
Class - 9th : Movements
Class - 9th : Pravesha steps
Class - 10th :Pravesha nade in full form
Class - 11th and 12th: Revision
Class - 13th : Eripada, ettugade, eripada steps
Class - 14-20 : Practice and Assessment
Class - 21 to 35: Tala introduction. Slow talas and Yakshagana Prasanga practice (Abhinaya+ Presentation)

Suggested Reading/Resources

1	Arthayana: Yakshagana Talamaddale Arthagarike: Ondu Vishleshane: Dr.Ramananda Banari
2	Koralara: Yakshagana Vimarsha Sankalana: Dr.M.Prabhakara Joshi
3	Vaagartha Gawrava:(Dr. Joshi Abhinandana Guchaha):Ga. Na. Bhat

ENGINEERING ECONOMICS

Course Code:	MG1507-1	Credits	03

Course Objectives:

1.	Analyse the time value of money.
2.	Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost- benefit analysis).
3.	Take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
4.	Determine the cost involved in each operations, a product should undergo with an aim to fix suitable selling price for the product.
5.	Know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts.

UNIT-I

Fundamental economic concepts Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns(No exercises)	**07 Hours**
Interest Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].	**09 Hours**

UNIT-II

Rate of Returns Analysis based on Rate of Return, Exercises, cost of capital concepts	**04 Hours**
Depreciation Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance, SYD method, Sinking Fund method], Exercises	**04 Hours**

UNIT-III

Estimating and Costing	**05 Hours**

Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises Mensuration, Machine shop calculations, Forging shop calculations, Exercises		
Financial management Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.		**05 Hours**
TEXTBOOKS:		
1.	Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004	
2.	Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012	
REFERENCE BOOKS:		
1.	Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001.	
2.	Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.	
3.	Engineering Economics, Tarachand, Nemchand & Bros, 1996.	
4.	Financial Management, I M Pandey, Vikas Publishing House, 2002	
E Books / MOOCs/ NPTEL		
1.	http://nptel.ac.in/courses/112107209/	

PROGRAMMING FOR ENGINEERS WITH MATLAB

Course Code:	EE2106-1	Credits	03

Course Objective:

1. To get familiarized with concept of MATLAB programming for array, matrices, logical operations and conditional statements
2. To acquainted with MATLAB programming for numerical methods to solve differential equations.
3. To analyse the second order physical systems using MATLAB Simulink .

UNIT-I

15 Hours

An Overview of MATLAB®: MATLAB Interactive Sessions, Menus and the Toolbar, Script Files and the Editor/Debugger, The MATLAB Help System

Getting started: Creating MATLAB variables, Overwriting variable, Error messages, Managing the workspace, Miscellaneous commands

Arrays and Matrices: Creating vector, creating matrix, Matrix indexing, Colon operator, creating a sub-matrix, deleting row or column, Transposing a matrix, Concatenating matrices, Matrix generators, Special matrices, Matrix arithmetic operations, Array arithmetic operations, Matrix inverse

Control flow and operators: Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, for Loops, while Loops, The switch Structure, Operator precedence

Plots: Introduction to plots, x-y Plotting Functions, Additional Commands and Plot Types, Interactive Plotting, subplots, Three-Dimensional Plots.

Functions and Files: Elementary Mathematical Functions, User Defined Functions

UNIT-II

15 Hours

Linear Algebraic Equations: Matrix Methods for Linear Equations, The Left Division Method, Underdetermined Systems, Overdetermined Systems, A General Solution Program

Numerical Methods for Calculus and Differential Equations: Numerical Integration, Numerical Differentiation, First-Order Differential Equations, Higher-Order Differential Equations, Special Methods for Linear Equation

Statistics, Probability, and Interpolation: Statistics and Histograms, Normal Distribution. Random Number Generation, Interpolation

UNIT-III

10 Hours

Introduction to Simulink, Simulink model of a first order and second order systems, simulation of second order physical system using Simulink blocks (mathematical modelling).

Simscape: Introduction to Simscape, , Simulation of second order physical systems.

REFERENCE BOOKS:

1.	William J. Palm III, “Introduction to MATLAB® for Engineers“, Third Edition, 2011, McGraw-Hill.
2.	Timmy Siauw, Alexandre Bayen, “An Introduction to MATLAB® Programming and Numerical

	Methods for Engineers", 2014, Elsevier Science
3.	O. Beucher, M. Weeks, "Introduction to MATLAB & SIMULINK (A Project Approach)", Third Edition, 2008, Laxmi Publications Pvt Limited
4.	Eugeniy E. Mikhailov, "Programming with MATLAB for Scientists: A Beginner's Introduction", 2018, CRC Press
5.	Dorothy C. Attaway, Stormy Attaway, "MATLAB: A Practical Introduction to Programming and Problem Solving", 3rd illustrated edition, 2013, Elsevier Science
6.	Patrick Marchand, O. Thomas Holland, "Graphics and GUIs with MATLAB", Third Edition, 2003, CRC Press
7.	"Select a web site," Create and Run a Simple App Using App Designer - MATLAB & Simulink. [Online]. Available: https://www.mathworks.com/help/matlab/creating_guis/create-a-simple-app-or-gui-using-app-designer.html. [Accessed: 31-Dec-2022].

STATICS

Course Code:	CV1004-1	Credits	03

Course Objectives:

1.	To develop the analytical skills to solve coplanar concurrent and non-concurrent force system and analyze cylinders and strings using equilibrium conditions.
2.	To identify different types of supports, loadings and analyze determinate beams
3.	To develop the student's ability to find out the center of gravity and moment of inertia and their applications.
4.	To analyse the structures trusses, frames and moments of inertia of masses by the method of virtual work.

UNIT-I

16 Hours

Basic idealizations - Definition of force, Characteristics of a force, forces in plane, forces in space, Force systems and classification; Axioms of Mechanics. Concept of free body diagram.
Resolution of forces, Composition of forces - Definition of Resultant; Resultant of coplanar concurrent force system.
Moment of a force, couple, characteristics of couple, Equivalent force - couple system; Varignon's theorem, Resultant of coplanar - non-concurrent force system.
Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems. Equilibrium in two and three dimensions.

UNIT-II

15 Hours

Equilibrium of coplanar non concurrent force systems: Simple, Hinged and fixed supports, Point, udl and uvl loads, support reactions for statically determinate beams.
Centroid of plane figures; Locating the centroid of rectangular, triangular, semicircular, quarter of a circular area and sector of a circular areas using method of integration, Centroid of simple built up sections.
Moment of inertia of an area, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangular, triangular, semicircular and quarter of a circular area from the method of integration; Moment of inertia of composite areas.

UNIT-III

09 Hours

Analysis of structures: trusses, frames and machines, internal forces in beams and cables, moments of inertia of masses, method of virtual work.

TEXTBOOKS:

1.	Ferdinand L. Singer "Engineering Mechanics"
2.	Irving H. Shames (2012), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited. ISBN: 978-8-131-72883-3

REFERENCE BOOKS:

1.	Ferdinand P. Beer and E. Russel Johnson, "Mechanics for Engineers: Statics and dynamics" McGraw-Hill Book Company, New York.
2.	Timoshenko and Young, "Engineering Mechanics" McGraw-Hill Book Company, New Delhi.

3.	Merium J.L, Kraige L.G, Engineering Mechanics Vol.I & II Wiley Publishers.
4.	McLEAN and Nelson, “Engineering Mechanics” (Schaum’s outline Series), McGraw-Hill Book Company, New Delhi.

INDIAN CULTURE – MUSIC			
Course Code:	**HU1510-1**	**Credits:**	**3**

Course Objectives

Music has its own place in making of Indian Culture. It has contributed extensively to the colours of Indian culture and tradition. The study of this paper enables the students to understand various aspects of Indian Music and forms of Indian Music.

UNIT-I	20 Hours
The course contents involve the discussion on historical overview, growth of various music form and royal patronage, discussion on various classifications – classic (Hindustani and Carnatic), folk music and its regional diversities and forms (bihu, bauls, bhangra, dandiya, ganasangeet, uttarakhandi, lavani, popular, qawwali, rabindra sangeet, rajastani)	
UNIT-II	**20 Hours**
modern music forms (Indian popular music – filmy music, rock and metal music, dance music, western music, Dasa Sahitya, Musicians – both vocalist and instrumentalists,	
UNIT-III	**12 Hours**
eminent contributions and scholars of Indian music, various forms of musical instruments, basic dimensions of music – raga, laya, bhava and tala.	

MATRICES

Course Code:	MA2012-1	Credits:	03

Course Objectives:

1.	Objective: Linear algebra is one of the important branches of mathematics which finds applications in all branches of engineering. This course is designed to equip the students with the basics of linear algebra.

40 Hours

Introduction to matrices, elementary transformations, rank of a matrix, systems of linear equations, echelon form of matrices, vector equation, matrix equation, solution sets of linear systems, linear independence.

Introduction to linear transformation, The matrix of a linear transformation, matrix operations, the inverse of a matrix, characterization of invertible matrices, Vector spaces, subspaces of Rn, linear combination of vectors, basis, dimension.

Introduction to determinants, properties of determinants, Cramer's rule, eigenvectors and Eigen values, diagonalization, Eigen vectors and linear transformations, inner product, length and orthogonality

Orthogonal sets, orthogonal projections, The Gram-Schmidt Process

TEXTBOOKS:

1.	Linear algebra and its applications by David C. Lay
2.	Linear algebra by Gilbert Strang.

STUDY OF DYNAMICS

Course Code:	CV1006-1	Credits	03

Course Objectives:

1.	To define basic kinematic quantities of rectilinear and curvilinear motion of particle such as: position, displacement, velocity and acceleration,
2.	To explain basic terms in kinetics of particles: Newton’s second law, work and kinetic energy, impulse and momentum, gravitational and elastic potential energy
3.	To explain plane kinetics of rigid bodies
4.	To discuss direct and oblique central impact
5.	To analyse and comprehend free undamped and damped vibrations Understand the importance of Civil Engineering and develop the analytical skills to solve coplanar concurrent force system

UNIT-I

10 Hours

Introduction into Engineering Mechanics-Dynamics.
Basic quantities and units. Newton’s laws of motion and law of gravitation.
Kinematics of particle: Rectilinear motion and basic kinematic quantities: position, displacement, velocity and acceleration. Special cases of rectilinear motion of particle: motion with constant velocity and motion with constant acceleration. Dependent rectilinear motions. Curvilinear motion of particle: position vector, velocity and acceleration. Free flight of a projectile.
Tangential and normal components of acceleration. Radial and transvers components of velocity and acceleration.
Kinetics of particles: force and acceleration. Newton’s second law.

UNIT-II

10 Hours

D’Alembert’s principle - dynamic equilibrium.
Definition of work, kinetic energy and power. Work of a gravitational force. Work of a spring force. Principle of work and energy. Potential energy: gravitational and elastic.
Impulse and momentum. Principle of impulse and momentum.
Angular impulse and angular momentum.
Impact: direct central impact; oblique central impact.

UNIT-III

10 Hours

Plane kinematics of rigid bodies. Types of plane motion of rigid bodies: translation, rotation, general plane motion. Velocity and acceleration centre. Accelerations in different reference frames.
Interpretations for Coriolis acceleration.
Plane kinetics of rigid bodies. Mass moments of inertia, parallel-axis theorem, calculation mass moments of inertia for composite bodies.
Vibrations. Undamped free vibrations. Damped free vibrations.

TEXTBOOKS:

1.	Hibbler, R.C. “Engineering Mechanics” (Statics and Dynamics)”.
2.	Beer F.P. and E.R. Johnson “Vector Mechanics for Engineers”, , 2nd Edition, Tata McGraw Hill

	Publishing Co. Ltd.
REFERENCE BOOKS:	
1.	Shames, I.H "Engineering Mechanics – Statics and Dynamics", 3rd Edition, New Delhi, Prentice Hall of India.
2.	Egor .P. Popov "Engineering Mechanics of Solids", 2nd Edition, New Delhi, Prentice Hall of India.

ELECTRICAL CIRCUITS AND POWER DISTRIBUTION

Course Code:	**EE2105-1**	**Credits:**	**03**

Course Objectives:

1.	To familiarize the student with the DC circuit analyses.
2.	To analyze single and three-phase AC circuits.
3.	To understand the working principle of electrical machines.

UNIT-I

Circuit Fundamentals — **05 Hours**

Basic nodal and mesh analysis excited by independent DC voltage sources, Power, and Energy. Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities. Star delta transformations.

A.C. Circuits — **11 Hours**

Single Phase AC Circuits:

Analysis of R, L, C, R-L, R-C and R-L-C series and parallel circuits for sinusoidal excitation. Phasor Diagrams. Real power, reactive power, apparent power, and power factor. Resonance: Series and parallel resonance, concept of band width and Q factor.

Three phase AC circuits:

Three-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of three phase power using two wattmeters. three phase four wire circuits.

UNIT-II

DC motors — **06 Hours**

Constructional details, Principle of operation of motor, Expression for back emf, Types of dc motors, Characteristic of dc motors (shunt and series motors only) and Applications.

Single-Phase Transformers — **09 Hours**

Faradays Laws, self and mutually induced emfs. Necessity of transformer, Principle of operation. Types of Transformers, Emf equation, phasor diagrams at no load and full load, equivalent circuit, losses, efficiency, problems on emf equation and efficiency, Autotransformer, Applications.

UNIT-III

Three Phase Synchronous Machines — **04 Hours**

Basic parts, Principle of operation, Synchronous speed, Frequency of generated voltage, Emf equation. Concept of winding factor .Principle of operation of Synchronous Motor. Applications

Induction Motors — **05 Hours**

Concept of rotating magnetic field, Construction and working of a three-phase Induction Motor, Slip and its significance, Torque slip characteristics (qualitative). Necessity of a starter, Principle of operation Single Phase Induction Motor. Applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 2
EE2105-1.1	2	3												
EE2105-1.2	2	3												
EE2105-1.3	2	3												
EE2105-1.4	2	3												
EE2105-1.5	2	3												

1: Low 2: Medium 3: High

TEXTBOOK

1. Hughes, Edward, "Electrical Technology", Pearson Education Publications, 10th Edition, 2010.
2. W.H. Hayt and J.E Kemmerley, “Engineering circuit Analysis”, McGrraw Hill, 8th Edition 2014
3. Alexandar S Langsdorf, Theory of Alternating Current Machinery, McGrawhill

REFERENCE BOOKS:

1. Vincent Del Toro, "Electrical Engineering Fundamentals", 2nd Edition, Pearson, 2015.
2. H. Cotton, "Electrical Technology", CBS; 7th Edition, 2005.
4. Debashisha Jena, "Basic Electrical Engineering", Wiley India Private Limited, 2012.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/courses/108105053/

ENGINEERING MATHEMATICS III

Course Code:	MA2011-1	Credits:	04

Course Objectives:

1.	Differential equation is an integral part of any engineering curriculum. Most of the engineering problems are modeled as differential equations. This course is expected to help the students to solve the differential equations. Numerical approach to the solution of differential equation is also discussed

UNIT-I	20 Hours

Differential Equations:
Order and degree of a differential equation, Solutions of differential equations of first order and first degree. Variables separable, homogeneous , exact , linear equations and reducible to above types. Illustrative examples from Engineering field. Orthogonal trajectories of Cartesian and polar curves.

Second and higher order linear differential equations with constant coefficients. Method of undetermined coefficients. Method of variation of parameters, Solution of Cauchy's homogeneous linear equations. Applications to engineering problems

Partial differential equations:. Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions. Derivation of one dimensional heat and wave equations, D' Alembert's solution of wave equation, Solution of equation of the type Pp+Qq = R, Solution of PDEs by the method of separation of variables, method of transformation.

Numerical methods:
Finite difference expressions for first and second order derivatives (ordinary and partial). Numerical solution of ordinary differential equations. Classification of second order partial differential equations. Numerical solutions of Laplace and Poisson equations by standard five point formulae and heat and wave equations by explicit method.

Textbooks:

1.	A First Course in Differential Equations by E.D. Rainsville,
2.	Kreysizg: "Advanced Engineering Mathematics", John Wiley and Sons VI-Edition

ENGINEERING ETHICS

Course Code:	HU1511-1	Credits	03

Course objectives

Understand the need for professional ethics, responsibility in engineering. Discuss the range of ethical issues in an engineering career. Understand the important codes of ethics as developed by engineering organizations in engineering ethics. Understand the social and value dimensions of technology, role of engineers in organization and environment. Know about honesty and dishonesty in engineering profession and understand the code of ethics developed by different professional engineering societies.

UNIT-I

Why professional ethics – what is a profession, engineering and professionalism, two models of professionalism, three types of ethics or morality, negative face of engineering ethics, positive face of engineering cases, case studies. **Responsibility in engineering** – introduction, engineering standards, the standard of care, blame-responsibility and causation, liability, design standards, the range of standards of practice, the problem of many hands, impediments to responsible action, **Professionalism and code of ethics** – introduction, is engineering a profession, codes of ethics **Understanding ethical problems** **Ethical problem solving techniques** **Risk, safety and accidents**	**17 Hours**

UNIT-II

The social and value dimensions of technology – thinking about technology and society, technological optimism and technological pessimism, computer technology: privacy and social policy, how shall we design, ethical issues in design. **Engineers in organization** – introduction, professional responsibilities, professional rights, whistleblowing, **Engineers and environment** – introduction, environmental codes, the progressive attitude towards environment, going beyond law, respect for nature, should engineers have environmental obligations?	**13 Hours**

UNIT-III

Trust and reliability – introduction, honesty, forms of dishonesty, why is dishonesty wrong, dishonesty on campus, dishonesty in engineering research and testing, confidentiality, intellectual property, expert witnessing, informing the public, conflicts of interest. **Doing the right thing** **Codes of ethics of Professional Engineering Societies**.	**10 Hours**

TEXTBOOKS:

1.	Charles E Harris, Michael S. Pritchard & Michael J. Rabins, Engineering Ethics – Concepts and Cases, Fourth Edition, WADSWORTH CENGAGE Learning, 2009, ISBN-13: 978-0-495-50279-1 ISBN-10: 0-495-50279-0
2.	Charles B. Fledderman, Engineering Ethics, Fourth Edition, Pearson, 2012, ISBN-13: 978-0-13-

	214521-3 (alk. paper) ISBN-10: 0-13-214521-9 (alk. paper)

ENGINEERING PHYSICS-III			
Course Code:	**PH1002-1**	**Credits:**	03

Course Objectives:

This course is designed to provide students with a working knowledge of the elementary physics principles mentioned above, as well as their applications, and to enhance their conceptual understanding of physical laws. Students will attend two lectures and one hour activity period per week. Course evaluation is based on a combination of regular homework sets and/or quizzes, reports from the activity period, midterm and final exams and other evaluative tools. The course is an important prerequisite for later work in many science and engineering disciplines.

52Hours

Calculus-based introduction to the basic concepts of wave motion, geometrical optics, interference phenomena, photons, wave mechanics, and the structure of matter, including such topics as: electromagnetic waves: Poynting Vector, polarization and reflection, geometrical optics: mirrors, refraction, lenses, optical instruments, interference and diffraction, photons and matter waves, energy quantization, structure of matter: hydrogen atom, conduction of electrons in solids, and nuclear physics and nuclear energy.

TEXT BOOKS

1. ***Fundamentals of Physics (Parts 4 & 5)*** by David Halliday, Robert Resnick and Jearl Walker 8^{th} Edition, John Wiley and Sons, Inc
2. ***University Physics*** by Young and Freedman, 11th edition , Pearson Education Inc