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

Scheme & Syllabus for
M.Tech.
Computer Science and Engineering

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
2023-25

M. Tech. in Computer Science and Engineering

CREDIT DISTRIBUTION

No.	Course Category	Suggested Credits
1.	Professional Courses (PCC) – core	16
2.	Professional Courses (PEC) – elective	18
3.	Research Methodology & IPR/RETP	04
4.	Labs	04
5.	Project Work (UCC) (Phase 1 & 2)	08+20
6.	Audit Courses (2 Nos)	00
7.	Seminar on Current Topic (UCC)	02
8.	Internship (UCC)	08
Total Credits to be earned:		**80**

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

Off-Campus Centre, Nitte - 574 110, Karkala

M.Tech. (CSE): Scheme of Teaching and Examinations 2023-25

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2022 - 23)

1st Year Scheme

I SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	23CSE101	Advanced Data Structures and Algorithms	CSE	4	0	0	3	50	50	100	4
2	PCC	23CSE102	Advanced computer networks	CSE	4	0	0	3	50	50	100	4
3	PEC	23CSE11X	Elective – I	CSE	3	0	0	3	50	50	100	3
4	PEC	23CSE12X	Elective – II	CSE	3	0	0	3	50	50	100	3
5	PEC	23CSE13X	Elective – III	CSE	3	0	0	3	50	50	100	3
6	RETP	23CSE103	Research Experience Through Practice -I	CSE	Four contact hours /week for carrying out Research and Interaction between the faculty and students			-	100	0	100	2
7	PCC	23CSE104	Advanced Data Structures and Algorithms Lab	CSE	0	0	2	3	50	50	100	1
8	PCC	23CSE105	IoT Lab	CSE	0	0	2	3	50	50	100	1
9	AUDIT	23CSEAUX	Audit Course-I	CSE	2	-	-	-	-	-	-	-
				Total	**19**	**0**	**4**	**21**	**450**	**350**	**800**	**21**

II SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	23CSE201	Artificial Intelligence and Machine Learning	CSE	4	0	0	3	50	50	100	4
2	PCC	23CSE202	Big Data Analytics	CSE	4	0	0	3	50	50	100	4
3	PEC	23CSE21X	Elective – IV	CSE	3	0	0	3	50	50	100	3
4	PEC	23CSE22X	Elective – V	CSE	3	0	0	3	50	50	100	3
5	PEC	23CSE23X	Elective – VI	CSE	3	0	0	3	50	50	100	3
6	RETP	23CSE203	Research Experience Through Practice -II	CSE	Four contact hours /week for carrying out Research and Interaction between the faculty and students			-	100	0	100	2
7	PCC	23CSE204	Machine Learning Lab	CSE	0	0	2	3	50	50	100	1
8	PCC	22CSE205	Big Data Analytics Lab	CSE	0	0	2	3	50	50	100	1
9	AUDIT	23CSEAUX	Audit Course-II	CSE	2	-	-	-	-	-	-	-
				Total	**19**	**0**	**4**	**21**	**450**	**350**	**800**	**21**

Note: PCC: Professional Core Course, PEC: Professional Elective Course, AUDIT (AU): Non-credit Audit course, RETP: Research Experience Through Practice.
L –Lecture, T – Tutorial, P- Practical/ Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

2nd Year Scheme

III SEMESTER												
Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	UCC	23CSE301	Industry Internship/ Research Internship/Mini Project	CSE	8 Weeks Full Time [40-45 Hrs/week]			3	100	0	100	8
2	UCC	23CSE302	Seminar on Special Topic	CSE	0	0	2	3	100	0	100	2
3	UCC	23CSE303	Project Part -1	CSE	12 Weeks Full Time [Min 30 Hrs/week]			3	200	0	200	8
				Total	**0**	**0**	**2**	**9**	**400**	**0**	**400**	**18**
Note: L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.												
Internship: CIE Evaluation is for 100 Marks where 50 Marks is for Report and 50 Marks for the Presentation												
Project Part-1: CIE Evaluation is for 200 Marks where 100 Marks is for Report and 100 Marks for the Presentation												

IV SEMESTER												
Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	UCC	23CSE401	Project Part -2	CSE	22 Weeks Full Time [Min 36 Hrs/week]			3	200	200	400	20
				Total	**0**	**0**	**0**	**3**	**200**	**200**	**400**	**20**
Note: L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.												
Project Part-2: CIE Evaluation is for 200 Marks having Project Progress Evaluation (PPE)-1 and PPE-2 each for 100 Marks.												

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M.Tech. (CSE): Scheme of Teaching and Examinations

2023-25

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022 - 23)

ELECTIVE –I		ELECTIVE –II		ELECTIVE –III	
23CSE111	Advanced Database Management Systems	23CSE121	Data Science Concepts and Applications	23CSE131	Cloud computing
23CSE112	Compiler Optimization & Multi-core Architecture	23CSE122	Advances in Computer Vision	23CSE132	Business Intelligence
23CSE113	Cyber Security & Forensics	23CSE123	Natural Language Processing	23CSE133	Agile Technologies
23CSE114	Design Thinking	23CSE124	Cryptography & Network Security	23CSE134	Social & Web Analytics

ELECTIVE –IV		ELECTIVE – V		Elective - VI	
23CSE211	Distributed Operating System	23CSE221	Wireless Networks	23CSE231	Blockchain Technology
23CSE212	Deep Learning	23CSE222	General Purpose Computation on GPU	23CSE232	Speech Processing
23CSE213	Computer Vision	23CSE223	Analysis of Computer Networks	23CSE233	Software Engineering and Modelling
23CSE214	Distributed Systems	23CSE224	Image Processing and Analysis	23CSE234	Web Services

Note: - MOOC course may be taken in place of group - V elective in 2nd semester.

POs

1. An ability to independently carry out research /investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. (The mastery should be at a level higher than the requirements in the appropriate bachelor program)
4. Identify, formally model, define, and solve computing problems by applying the knowledge of mathematical principles, theoretical foundations, and limits of computing.
5. An ability to apply the computational concepts and logics to address a real time problem and to develop software systems, products and processes that are practically feasible to implement using modern tools.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An ability to communicate effectively with a wide range of audience.
8. Recognize the need to engage in self-governing and life-long learning by making use of professional and ethical principles.

PSOs

PSO 1: Proficiency in analysis, design, development and implementation of efficient solutions for real time computational problems applying problem solving skills and turn out to be employable in product-oriented Industry.

PSO 2: An understanding of the modern tools, technologies and architecture of computation to carry out research in order to design and improve the solution for any computational problems.

Advanced Data Structures and Algorithms

Course Code	:	23CSE101		**CIE Marks**	:	50
Teaching Hours /Week (L:T:P:S)	:	4-0-0-0		**SEE Marks**	:	50
Total Hours	:	50		**Credits**	:	4

Course Objectives:

After successful completion of this course students will be able to:

1. Describe basic data structures and apply appropriate data structure for solving the problem
2. Describe different types of tree data structure and apply the same in problem solving.
3. To analyze the efficiency of recursive and non-recursive algorithms and to understand the concepts of amortized analysis of algorithms.
4. To analyze the various graph algorithms and evaluate its efficiency.
5. To analyze various string matching algorithms and randomized, probabilistic algorithms.

Unit 1

Introduction to Data structures, Basic data structures stacks, queues and circular queues using dynamic arrays, linked lists: Stacks and queues using SLL, DLLand circular linked list. Sparse matrix representation using linked list

Hashing: Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

10 Hours

Unit II

Binary trees: Types of binary trees, Binary tree representation, tree traversals, Selection trees, Binary Search Trees, AVL Trees, Red Black Trees, multi way search trees, B-Trees, 2-3 Trees, B+ trees, Splay Trees, Skip lists

10 Hours

Unit III

Review of Analysis Techniques : Growth of Functions: Asymptotic Notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations - The Substitution Method, The Recurrence tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

10 Hours

Unit IV

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG;Johnson's Algorithm for sparse graphs; Flow networks and Ford- Fulkerson method; Maximum bipartite matching.

10 Hours

Unit V

String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer– Moore Algorithm.

Probabilistic algorithms; Randomizing Deterministic Algori**thms** **10 hours**

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

1. Apply suitable data structures to solve the problems, design stack, Queues using dynamic arrays and linked lists and apply hashing concept in searching.
2. Use vanity of trees for problem solving
3. Analyze the efficiency of recursive and non-recursive algorithms and to understand the concepts of amortized analysis of algorithms.
4. Analyze the various graph algorithms and evaluate its efficiency.
5. Analyze various string matching algorithms and randomizing algorithms.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3	1	2						3	2
2	3	1	2						3	2
3	3	1	2						3	2
4	3	1	2						3	2
5	3	1	2		3				3	2

TEXTBOOKS:

1.Ellis Horowitz, Sartaj Sahni "Fundamental of Data structures in C", Second edition, Universities Pres.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004. 2. M T Goodrich Roberto Tamassia, Algorithm
3. T Cormen, C Leiserson, Rivest Introduction to Algorithms, third edition, PHI 2007.
4. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Second edition, Pearson edition

.Reference Book:

1. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman
2. H. S. Wilf, Algorithms and complexity, Prentice hall.

ADVANCED COMPUTER NETWORKS

Course Code	:		**CIE Marks**	:	50
Teaching Hours /Week (L:T:P:S)	:	4	**SEE Marks**	:	50
Total Hours	:	50	**Credits**	:	

Course Objectives:

After successful completion of this course students will be able to:

1. Describe the basics of the computer networking and the network layer.
2. Explain the end to end protocols like TCP, UDP and congestion control techniques utilized by these protocols.
3. Explain the delivery of the multimedia data over the network with the help of the corresponding protocol.
4. Describe the 802.11 wireless LANs, internet access in the wireless paradigm, mobile IP and its concepts.
5. Describe wireless sensor technology and software defined networks.

UNIT–I

Introduction: Data communications, Networks, the internet, protocols and standards. **Network Models:** Layered tasks, The OSI model, Layers in the OSI model, TCP/IP protocol suite, addressing. **Network Layer:** Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6. **10 Hours**

UNIT – II

Transport Layer: Process to Process delivery, UDP, TCP. **Congestion Control and Quality of Service**: Data traffic, Congestion, Congestion Control, Two examples, Quality of service, Techniques to improve QoS, Integrated services, differentiated services. **10 hours**

UNIT–III

Multimedia Networking: Multimedia Networking Applications, Streaming Stored Video, Voice-over-IP, Protocols for real time conversational applications, Network support for multimedia. **10 hours**

UNIT-IV

Wireless and Mobile Networks: Introduction, wireless links and network characteristics, Wifi: 802.11 wireless LANs, Cellular Internet Access, Mobility Management: Principles, Mobile IP, Managing Mobility in Cellular Networks. **10 hours**

UNIT-V

Wireless Sensor Networks: Introduction and Overview, Application of Wireless Sensor Networks, Basic Wireless Sensor Technology. **Software Defined Networks**: Introduction, Why SDN? Use cases for input traffic monitoring. **10 hours**

Course Outcomes:

Upon completion of this course, students will be able to:

1. **Illustrate** the basics of networking and the working of the network layer.
2. **Demonstrate** the end to end protocols like TCP, UDP and congestion control techniques utilized by these protocols.
3. **Describe** the delivery of the multimedia data over the network with the help of the corresponding protocol.
4. **Illustrate** the 802.11 wireless LANs, internet access in the wireless paradigm, mobile IP and its concepts.
5. **Describe** the wireless sensor technology and software defined networks.

TEXTBOOKS:

1. Behrouz A. Forouzan, Data Communications And Networking, 4th Edition, McGraw-Hill Forouzan Networking Series.
2. James F. Kurose and Keith W. Ross, Computer Networking- A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education.
3. Kazem Sohraby,Daniel Minoli,Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, A John Wiley and Sons Publication.
4. Paul Göransson, Chuck Black, Software Defined Networks: A Comprehensive Approach, Elsevier.
5. Thomas D. Nadeau and Ken Gray, SDN: Software Defined Networks,1st Edition, O'Reilly Publication.

REFERENCE BOOKS:

1. Peterson and Davie, Computer Networks: A systems Approach, 5th Edition, Morgan Kaufmann publication.
2. Andrew S. Tanenbaum**,** Computer Networks, Fourth edition, PHI / Pearson Publication, 2002.

IoT Lab

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a programe to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a programe to turn ON motor when push button is pressed.
6. T0 interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code:	**23CSE201**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4+0+0+0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	To understand the basics of AI.
2.	To work with the problem solving issues of AI.
3.	To study planning and knowledge Engineering.
4.	To apply the AI concepts to various applications.
5.	To understand and apply the ML concepts like SVM, BBN to solve problems.

UNIT-I	
Introduction to Artificial Intelligence and machine learning, Applications of AI. Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces. Problem Solving: state space search and control strategies. Informed Search Methods: Best-First Search, Heuristic Functions, Memory Bounded Search, and Iterative Improvement Algorithms.	**10 Hours**
UNIT-II	
Problem reduction and Game playing, Logic concepts and logic programming. Building a Knowledge Base; Properties of Good and Bad Knowledge Bases, Knowledge Engineering. The Electronic Circuits Domain, General Ontology, The Grocery Shopping World. Inference in First-Order Logic: Inference Rules Involving Quantifiers, An Example Proof. Generalized Modus Ponens, Forward and Backward, Chaining & Completeness, Resolution: A complete Inference Procedure, Completeness of Resolution.	**10 Hours**
UNIT-III	
Planning A Simple Planning Agent Form Problem Solving to Planning. Planning in Situation Calculus. Basic Representations for Planning. A Partial-Order planning Example, A partial Order planning algorithm, Planning With partially Instantiated Operators, Knowledge Engineering for Planning. Advanced problem-solving paradigm: planning Knowledge representation	**10 Hours**
UNIT-IV	

Uncertainty Measure: Probability Theory, Bayesian Belief Networks, Machine Learning Paradigms: Machine learning system, supervised and unsupervised learnings, Inductive, deductive learning, Clustering.	**10 Hours**
UNIT-V	
Support vector Machine, case-based reasoning and learning. ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network.	**10 Hours**

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

1.	Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
2.	Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems
3.	Demonstrate handling of uncertain knowledge and planning in AI.
4.	Understanding of probability theory and learning methods.
5.	Analyze the given problem to apply a suitable method of AI to solve the engineering problem.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	3	1				1	2	1	1
2	3	2	1			1		2		1
3	3	2	2	2				2	2	
4	3	2		2				2	2	
5	3	3	2	2	2			2	1	3

TEXTBOOKS:

1.	Eliane Rich, Artificial Intelligence, McGraw Hill International student edition, 1984.
2.	Machine Learning, Tom Mitche, McGraw Hill, 1997

REFERENCE BOOKS:

1.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundation of Machine MIT Press,2012.

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MACHINE LEARNING LAB

Course Code:	**23CSE204**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0+0+2+0**	**Credits:**	**01**
Total Teaching Hours:	**2**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	To understand the basics of Datastructures
2.	To apply the ML concepts to solve problems.

List of Experiments

1.	
1.	the basics of data structures like Linked list, stack queue, set and map in Java.
2.	Adaboost and Bagging using Random Forests.
3.	Logistic Regression
4.	NEURAL NETWORK Graphs for different activation functions: sigmoid, Tanh, ReLu Parameter Initialization: Simple neural network for Iris dataset.
5.	DEEP LEARNING Caffe: for different deep learning architectures like DBN, CNN, RNN, LSTM, DSN Application:

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

1.	Implement the ML concepts using python programming
2.	Design solutions to given problem by using appropriate concepts

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	1	2	2	1			1	2		
2	3	2	2	2			1	2		

REFERENCE BOOKS:

1.	Abhishek Vijayvargiya, Machine Learning for Python: An Approach to Applied Machine Learning, BPB Publications.

BIG DATA ANALYTICS			
Course Code:	**23CSE202**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**5+0+0+0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

UNIT-*I*

Introduction to Big Data: Types of digital Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What Is Big Data? Why Big data? Traditional BI versus Big data.Big Data Analytics: What is Big Data Analytics? Why this sudden Hype around Big Data analytics? Data Science, Terminologies used in Big Data environments

Introduction to NoSQL: Where it is used, Types of NoSQL databases, Why NoSQL, Advantages of NoSQL,

Introduction to MongoDB: What is MongoDB? Why MongoDB? Using JSON, Creating or generating a unique key, Data types in MongoDB, MongoDB Query Language: Insert method, Save
method, Update method, Remove method, Find method, Dealing with Null values, Count, Limit, Sort, Skip.

10 Hrs

UNIT II

Introduction to Hadoop : Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop , Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System) , Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator).

Writing Hadoop MapReduce Programs: Understanding the basics of MapReduce, Introducing Hadoop MapReduce,Understanding the different Java concepts used in Hadoop programming,.

10 Hrs

UNIT-III

Writing a Hadoop MapReduce example, Understanding several possible MapReduce definitions to solve business problems

SPARK: Spark applications, Jobs, stages and Tasks, Resilient Distributed Datasets(RDD), Anatomy of SPARK Job Run; SPARK on YARN

10 Hrs

UNIT IV

Hadoop Ecosystem: Understanding Hadoop subprojects: Mahout, Apache HBase, Hive, Pig, Apache Sqoop, Apache Zookeeper, Apache Solr, Ambari.

HBase: What is HBase? Storage Mechanism in HBase, Features of HBase, HBase and RDBMS, HBase and HDFS.

10 Hrs

UNIT V

Introduction to Pig: What is Pig? Pig on Hadoop, Pig Philosophy, Pig Latin overview; Pig Data Types; Running Modes of Pig; Execution Modes of PIG, Relational operators, EVAL function, Complex data types.

Introduction to Hive: What is Hive? Architecture; HIVE Data Types; HIVE File Format; Hive Query Language(HQL).

10 hrs

TEXTBOOKS:	
1.	SeemaAcharya, SubhashiniChellappan, "Big Data Analytics", 1st Edition, Wiley, 2015.
2.	Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing 2013.
3.	Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilley, 2012.
REFERENCE BOOKS:	
1.	V1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2.	Chris Eaton, Dirk derooset al., "Understanding Big data ", McGraw Hill, 2012.
3.	E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, O'Reilley, 2012.
4.	Lars George, HBase: The Definitive Guide, O'Reilley, 2011.
5.	Alan Gates, Programming Pig, O'Reilley, 2011
E Books / MOOCs/ NPTEL	
1.	https://www.upgrad.com/big-data-analytics-

BIGDATA ANALYTICS LAB			
Course Code:	23CSE205	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0+0+2+0**	**Credits:**	**01**
Total Teaching Hours:	**2**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	**Demonstrate** the knowledge of big data analytics and implement different file management task in Hadoop.,
2.	Implement different operations on PIG latin Scripts,
3.	Apply different operation on Hive

List of Experiments

1.	implement different file management task in Hadoop
2.	Understand Map Reduce Paradigm and develop data applications using variety of systems.
3.	perform different operations on data using Pig Latin scripts.
4.	apply different operations on relations and databases using Hive.

RESEARCH EXPERIENCE THROUGH PRACTICE -1			
Course Code:	**23CSE105**	**Course Type**	**RETP**
Teaching Hours/Week (L: T: P: S)	**0:0:4:0**	**Credits**	**2**
Total Teaching Hours	**24**	**CIE + SEE Marks**	**50+50**

Teaching Department: CSE

Course Objectives: The research purposes are

- To foresee future problems through pursuit of truth as a "global centre of excellence for intellectual creativity".
- To respond to current social demands, and to contribute to the creation and development of scientific technologies with the aim of realizing an affluent society and natural environment for humanity.
- At the same time, the course aims to create excellent educational resources and an excellent educational environment through frontline researches
- To Understand professional writing and communication contexts and genres, analyzing quantifiable data discovered by researching, and constructing finished professional workplace documents.

Individual PG Students are to be allotted to the individual faculty members based on student's area of research interest, specialization of faculty members in the beginning of the first semester.

MODULE -1

Defining the research problem - Selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem - Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources - Reviews, treatise, monographs patents - web as a source - searching the web - Identifying gap areas from literature review - Development of working hypothesis, systematic way of conducting

research, write a review / research paper, research proposal, preparation of research report.

MODULE-2

- Introduction various simulation tools related to Computer Science
- Use of latest software tools that is related to the domain of the research.
- Introduction to typesetting tool (Latex).
- At the end of the course students should submit a research proposal and should present the idea.

The Research proposal report prepared based on the work carried out by the PG Student is evaluated for 50 marks and 20 minutes presentation on the research work carried out

will be evaluated for 50 marks jointly by the examiners.

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

1.	Identify and define the problem statement based on the literature reviewed.
2.	Formulate the objectives specific to the defined problem statement.
3.	Develop the methodology for achieving the objectives.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3	2	2						2	
2	3		2						2	
3	3		3							3

REFERENCE BOOKS:

1.	The Undergraduate Research Hand book. Gina Wisker · 2018

E Books / MOOCs/ NPTEL

Advanced Database Management Systems

Course Code:	**23CSE111**	**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**

Course Objectives:

1.	To understand the different methods in storing data in disks as files.
2.	To familiarize with different types of Indexing.
3.	To understand the Query evaluation process and evaluating operators.
4.	To understand the working of a typical query optimizer.
5.	To Familiarize with Distributed database concept, distributed database Architecture, Query processing and optimization in distributed database

UNIT-I

Storage and Indexing: Overview of storage and indexing - Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations. Storing data: disks and files: The Memory Hierarchy, Redundant Arrays of Independent Disks, Disk Space Management, Buffer Manager, Buffer Replacement Policies, Files of Records , Page Formats, Record Formats. Tree-structured indexing: Intuition for Tree Indexes, Indexed Sequential Access Method (ISAM). B+ Trees: A Dynamic Index Structure, Search, Insert, Delete, Duplicates, B+ Trees in Practice. Hash-based indexing: Static Hashing, Extendible Hashing, Linear Hashing, Extendable vs. Linear Hashing	**15 Hours**

UNIT-II

Query Evaluation: Overview of query evaluation: The System Catalog, Introduction to Operator Evaluation, Algorithms for Relational Operations, Introduction to Query	
Optimization, Alternative Plans: A Motivating Example, What a Typical Optimizer Does? External sorting: When Does a DBMS Sort Data?, A Simple Two-Way Merge Sort, External Merge Sort, Minimizing I/O Cost versus Number of I/Os, Using B+ Trees for Sorting. Evaluating relational operators: The Selection Operation, General Selection Conditions, The Projection	**15 Hours**

Operation, The Join Operation, The Set Operations, Aggregate Operations, The Impact of Buffering. A typical relational query optimizer: Translating SQL Queries into Algebra, Estimating the Cost of a Plan	

UNIT-III

Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalog Management	**10 Hours**

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

1.	Explain the different methods in storing data in disks as files.
2.	Illustrate with different types of Indexing.
3.	Perform the Query evaluation process and evaluate operators.
4.	Explain the working of a typical query optimizer.
5.	Explain the Distributed database concept, distributed database Architecture, Query processing and optimization in distributed database

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2						3	
2	3		2		2				2	3
3	3		2						3	
4	3		2						2	3
5	3		2		2				2	3

TEXTBOOKS:

1.	Database management systems / Raghu Ramakrishnan, Johannes Gehrke.3rd Edition Mc Graw Hill

REFERENCE BOOKS:

1.	Fundamental Database Systems Ramez Elmasri and Shamkant B. Navathe, 7th Edition., Pearson Publication

2.	Database System Concepts A. Silberschatz, Henry F. Korth ,S. Sudarshan Sixth Edition McGraw Hill Publication

COMPILER OPTIMIZATION AND MULTI-CORE ARCHITECTURES

Course Code:	**23CSE112**	**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**

Course Objectives:

1.	To familiarize principles of parallel programming
2.	To understand compiler optimizations
3.	To comprehend the parallel architectures
4.	To familiarize parallel programming paradigms

UNIT-I

Programming principles: Reactive parallel programming. Synchronization strategies, critical regions, atomic updates, races, deadlock avoidance, prevention, livelock, starvation, scheduling fairness, virtualization, speculative parallelization, transactional memories. **Optimizations:** Basic compiler optimizations, Control and data flow analysis, Enhancing parallelism, dependence analysis. Tiling for locality and communication, Aggregation for communication, Load balancing strategies, Register Allocation:Coloring, Spilling & IPA, Pointer alias Analysis ,Dynamic Code Optimizations and garbage collection,	**16 Hours**

UNIT-II

Automatic Programming: Program transformation by pattern matching, Partial evaluation, Object-oriented and Aspect-oriented programming, Automatic Parallelization I and II. **Overview of architectures:** Architectural characterization of most important Parallel systems today. Issues in effective programming of parallel architectures: exploitation of parallelism, locality (cache, registers), load balancing, communication, overhead, consistency, coherency, latency avoidance	**14 Hours**

UNIT-III

Programming paradigms: By the data: Partitioned data, global view of data, and no state. By control: Partitioned control, global view of control, functional control. Survey of programming languages/APIs:OpenMP and MPI.	**10 Hours**

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

1.	To explain the principles of parallel programming
2.	To perform different compiler optimizations
3.	To illustrate automatic parallelization
4.	To comprehend the parallel architectures
5.	To explain the parallel programming paradigms

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2		2	3	2			2	1	3
2	2		2	3	2			2	1	3
3	2		2	3	2			2	1	3
4	2		2	3	2			2	1	3
5	2		2	3	2			2	1	3

TEXTBOOKS:

1. Muchnick,StevenS.,Advanced Compiler Design and Implementation. MorganKaufmann,1997
2. LowryandMcCartney,Automating SoftwareDesign,AAAIPress,1991.
3. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann; 5 edition, 2011.

REFERENCE BOOKS:

1. Czarnecki,K.and Eisenecker,U., Generative Programming: Methods, Tools and Applications,Pearson,2000.
2. Maurice Herlihyand Nir Shavit ,The Art of Multiprocessor Programming, Morgan Kaufmann, Morgan Kaufmann; 1stedition, 2012.
3. Niranjan N. Chiplunkar and Raju K., Introduction to Parallel Computing. Wiley India,2020.

CYBER SECURITY & FORENSICS

Course Code:	**23CSE113**	**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**

Course Objectives:

1.	To understand the basics of cyber security.
2.	To understand the concepts of firewalls.
3.	To analyze the intrusion detection system and Hash authentication..
4.	To analyze phishing and identify the theft.
5.	To Understand the computer forensics.

UNIT-I

Cyber security Overview: Introduction, Security from Global Perspective, Trends in the Types of Attacks and Malware, The types of Malware, Vulnerability Naming Schemes and security configuration schemes, The attackers motivation and tactics, Zero-Day Vulnerability, Attacks on the power grids and Utility networks ,Network and Infrastructure Overview. Fire Walls : Firewalls, Stateless Packet Filtering, Stateful or session Filtering, Application level Gateways, Circuit level Gateways, A Comparison of Four types of gateways.	**15 Hours**

UNIT-II

Intrusion Detection / Prevention System : Overview, The approaches used for IDS/ IPS, Network Based IDS/IPS, Host Based IDS/IPS, The detection of Polymorphic and metamorphic worms, Distributed Intrusion Detection system and standard. Hash and Authentication: Authentication overview, Hash Functions, The Hash Message Authentication Code, Password Based Authentication, Password Based Encryption Standard, Password Based Security Protocols, One time password and tokens(only two factor authentication),Open Identification and Open Authorization.	**15 Hours**

UNIT-III

Phishing and Identity theft: Introduction, Phishing , Identity theft (ID) Cyber Crime and CyberSecurity: Introduction, Why do we need cyber laws: Indian context, The Indian IT Act, Challenges to Indian Law and cybercrime scenarios in India, Consequences of not addressing the weakness in information technology Act. Digital Signatures and Indian Act. Cyber Crime and Punishment	

Understanding Computer Forensics: Introduction, Digital forensics science, The need of computer forensics, Cyber forensics and digital evidence, Digital forensics life cycle, Network Forensics, Computer forensics and steganography	**10 Hours**

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

1.	To understand the basics of cyber security.
2.	To understand the concepts of firewalls.
3.	To analyze the intrusion detection system and Hash authentication..
4.	To analyze phishing and identify the theft.
5.	Understand the computer forensics.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2		1						3	1
2	2		1						2	3
3	2		1		3				3	2
4	2		1						2	3
5	2		1						3	1

TEXTBOOKS:

1.	Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Computer Networks and Cyber security, publication: : CRC press, Taylor and Francis group, 2013.
2.	Cyber Security –Nina Godbole, Sunit Belapure, Publication :John Wiley, 2012.
3.	Cyber security essentials --Edited by James Graham, Richard Howard, Ryan Olson, publication: CRC press, Taylor and Francis group, 2011.

DESIGN THINKING

Course Code:	**23CSE114**	**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**

Course Objectives:

1.	To provide a basic conceptual design thinking
2.	To explore customer need analysis.
3.	To understand the translation of customer needs.

4.	To work on problem decomposition.
5.	To understand product development process.

UNIT-I	
Introduction and problem discovery: Introduction to Design Thinking, People Centered Design &Evoking the Right problem, Skills expected of design thinking practitioners. Identifying Customer Needs: Product development process and concept, development phase in designplanning and analysis, Customer needs and markets, Types of product users Customer needs analysis.	**15 Hours**
UNIT-II	
Translating customer needs into measurable specifications: Bench marking needs vs. Specifications,Quality function deployment (house of quality), Dynamics of product specifications. Applied Creativity: Problem decomposition techniques and solution concepts, Brainstorming principles and their efficacy in creative thinking, System exploration and concept / down-selection	**15 Hours**
UNIT-III	
Design for Environment: DFE principles and decision making, How DFE integrates with the product development process,Product life cycle and environmental impacts, Herman Miller story.	**10 Hours**

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

1.	Examine Design Thinking concepts and principles
2.	Practice the methods, processes, and tools of customer need analysis.
3.	Apply the Design Thinking approach and model to real world situations and translate the needs to specifications.
4.	Analyze the role of primary and secondary research in the discovery stage of Design Thinking
5.	Apply the design thinking to real world problems.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2						3	2
2	3		2	3					3	2
3	3		2		3				3	2
4	3		2						3	2
5	3		2						3	2

TEXTBOOKS:	
1	Karl T. Ulrich, Steven. D. Eppinger, "Product design and development", Mcgraw hill publications, 5th ed., 2011.
2	Nanua Singh, "Systems approach to computer integrated design and manufacturing", Wiley India Pvt. Ltd., 4435-36/7, Ansari Road, Daryaganj, 1999.
3	Wake, Warren K., Design Paradigms A Source for Creative Visualization, NewYork: John Wiley & Sons, 2000.
4	Rowe, Peter G. Design Thinking, Cambridge, MA: MIT Press 1987.

Data Science Concepts and Applications

Course Code:	**23CSE121**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3+0+0+0**	**Credits**	**03**
Total Teaching Hours	**39**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	To Study the core concepts and technologies od data science
2.	To familiarize Mathematical and Statistical foundations for Data Science
3.	To study data processing, statistical technqiues
4.	To understand various machine learning algorithms
5.	To familiarize with data visualization tools with case studies

UNIT-I	
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications, Mathematical Foundations for Data Science: linear algebra; Analytical and numerical solutions of linear equations; Mathematical structures, concepts and notations used in discrete mathematics. Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics; Concepts of statistics in solving problems arising in data science.	**15 Hours**
UNIT-II	
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources. Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	**15 Hours**
UNIT-III	
Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings. Applications of Data Science, Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data. science. Case- studies	**9 Hours**

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

1.	Explore the fundamental concepts of data science
2.	Understand data analysis techniques for applications handling large data
3.	Understand various machine learning algorithms used in data science process
4.	Visualize and present the inference using various tools
5.	Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		1		1			1		1
2	1		1		1			1		1
3	1		1		1			1		1
4	1		1		1			1		1
5	3		1		1			1		1

1: Low, 2: Medium, 3: High

TEXTBOOKS:

1.	Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.
2.	Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016
3.	An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

Reference Books:

1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.
2. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015.
3. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
4. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014

ADVANCES IN COMPUTER VISION

Course Code:	**23CSE122**	**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**

Course Objectives:

1.	To explain the need of spatial and frequency domain techniques for image compression
2.	Identify, formulate and solve problems in image processing and computer vision.
3.	Critically review and assess scientific literature in the field and apply theoretical knowledge to identify the novelty and practicality of proposed methods
4.	Design and develop practical and innovative image processing and computer vision applications or systems

UNIT-I	
Introduction to Computer Vision: Goal,areas,Human Vision,Segmentation,Perception, Semantic information, Special effects, Modeling, Applications; Linear Algebra: Vectors Matrices,Transformation matrices,Matrix inverse,Matrix rank,SVD. **Pixels, Features, and Cameras: Pixels and Filters:** Images as functions, Linear Systems (filters),Convolution & Correlation. Edge detection: Simple, Canny, RANSAC; Feature detector: Localinvarient,Harris, DOG,SIFT;CameraModels	**15 Hours**
UNIT-II	
Camera: Pinhole Cameras, Cameras & lenses, Projection matrix, Intrinsic parameters, Extrinsicparameters; StereoVision: Epipolar Geometry, Parallelimages,Image Rectification,Solving correspondence problem,Active StereoVision System;	**15 Hours**
UNIT-III	

Regions of Images, and Segmentation:Basic Concepts of Segmentation:Gestalt Theory;Agglomerative, K-means & Mean-shift Clustering; Optical flow, Feature tracking, Applications;Advanced Image Parsing Topicand Applications:Binary,Image Matting;Figure-ground Segmentation Using Clustering Algorithms. **Recognizing Faces and Objects:** Basic Concepts in Recognition & its pipeline, Nearest NeighborMatch;PCA andEigenfaces; Tracking Millions of People: Detection, Tracklet Generation Association;	**10 Hours**

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

1.	Explain the need of spatial and frequency domain techniques for image compression.
2.	Identify, formulate and solve problems in image processing and computer vision.
3.	Critically review and assess scientific literature in the field and apply theoretical knowledge to identify the novelty and practicality of proposed methods
4.	Design and develop practical and innovative image processing and computer vision applications or systems
5.	Solve problems using the concepts of image segmentation, object recognition.

Program Outcomes→	1	2	3	4	5	6	7	8	PSO↓	
↓ Course Outcomes									1	2
1	2								3	2
2	1	2			3				3	2
3	2								3	2
4	2								3	2
5	2				3				3	2

TEXTBOOKS:

1.	Richard Szeliski,Computer Vision:Algorithms and Applications,Microsoft Research,Electronic draft,2010.
2.	DavidA.Forsyth &JeanPonce, Computer Vision:A Modern Approach, Prentice Hall; 2 edition,2011.
3.	Hartley & Zisserman,Multiple View Geometry in Computer Vision,Cambridge University Press;2 edition,2004.

REFERENCE BOOKS:

1.	Machine vision, Jain, Ramesh and Rangachar Kasturiand Brian G.Schunck;

	McGraw-Hill ,Edition-1995.
2.	Introductory Computer Vision And Image Processing, Low, Adrian; McGraw-Hill, Edition-1991. Digital Image Processing, Gonzalez, Rafael C. and Richard E.Woods; Addison-Wesley, Edition: 3rd, Year:1998.

NATURAL LANGUAGE PROCESSING

Course Code:	**23CSE123**	**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**

Course Objectives:

1.	To understand the basic concepts of natural language processing.
2.	To study the semantics and paradigms.
3.	To understand the algorithms used in NLP
4.	To know the implementation of NLP in python.

UNIT-I	
Introduction: What is Natural Language Processing, Motivation, Words - Regular Expressions and Automata, Words and Transducers, N-grams-Part–of-Speech Tagging, Hidden Markov Models, Maximum Entropy Model. Syntax:Syntactic Parsing, Statistical Parsing, Features and Unification-Languages and Complexity, Language Modelling.	**15 Hours**
UNIT-II	
Semantics and Pragmatics:Semantics and Pragmatics: The Representation of Meaning, Computational Semantics, Lexical Semantics: Computational Lexical Semantics, Computational Discourse. Applications:Applications, Information Extraction, Question Answering and Summarization,Dialogue And Conversational Agents, MachineTranslation.	**15 Hours**
UNIT-III	
NLP Using Python : Language Processing and Python - Accessing Text Corpora and Lexical Resources-Processing Raw Text-Writing Structured Programs-Categorizing and Tagging Words-Learning to Classify Text-Extracting Information from Text–Case Study.	**10 Hours**

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

1.	Analyze the natural language text to extract it into different parts of speech.
2.	Understand the syntax and the features of natural language text with respect to languages.
3.	Analyze the text to understand the various semantics and pragmatics
4.	Apply information retrieval techniques to natural language text.
5.	Implement the NLP concepts using python.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1				1					1	
2				1					1	
3				1					1	
4				1					1	
5	2	1		1	3				2	3

1

TEXTBOOKS:

1.	Allen, James,Natural LanguageUnderstanding,Second Edition,Benjamin/Cumming, 1995.
2.	Jurafsky, D. and J. H. Martin. Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Second Edition, Prentice Hall,2008.
3.	Steven Bird, S., Klein, E., Loper, E, Natural Language Processing with Python-Analyzing TextwiththeNaturalLanguageToolkit, O'ReillyMedia, 2010.

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code:	**23CSE124**	**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**

Course Objectives:

1.	To understand the requirements of information security.
2.	To understand the various fronts and the corresponding cryptographic techniques.
3.	To understand the importance of various authentication techniques and its applications.
4.	To understand the implementation of the cryptographic techniques.

5.	To understand the applications of the security techniques and the study of the common forms of the security threats.

UNIT-I	
Foundations of Cryptography and Security: Ciphers and Secret Messages; Security Attacks and Services. Conventional Symmetric Encryption Algorithms: Theory of Block Cipher Design; FeistelCipher Network Structures; DES and Triple DES; Modes of Operation (ECB, CBC, OFB, CFB);Strength(orNot)of DES; Rijndael (AES). Modern Symmetric Encryption Algorithms: Blowfish; Key Distribution. Public Key Cryptography:Prime Numbers and Testing for Primality; Factoring Large Numbers; RSA; Diffie-Hellman; KeyExchangeAlgorithm;	**16 Hours**
UNIT-II	
Hashes and Message Digests: Message Authentication; MD5; SHA; Digital Signatures: Certificates, User Authentication; Digital Signature Standard (DSSandDSA). Authentication of Systems: KerberosV4 and V5; X.509 Authentication Service. Elliptic curve cryptography, Electronic Mail Security: Pretty Good Privacy (PGP); S/MIME. IP andWeb Security: IPSec and Virtual Private Networks; Secure Sockets and Transport Layer (SSL andTLS).	**14 Hours**
UNIT-III	
Electronic Commerce Security: Electronic Payment Systems; Secure Electronic Transaction (SET);CyberCash, iKey Protocols; Digital Watermarking and Steganography, Intrusion detection, Viruses And Worms,Firewalls.	**10 Hours**

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

1.	Analyze and design classical encryption techniques and block ciphers.
2.	Understand and analyze public-key cryptography, RSA and other public-key cryptosystems such as Diffie-Hellman Key Exchange, ElGamal Cryptosystem, etc
3.	Understand key management and distribution schemes and design User Authentication Protocols.
4.	Analyze and design hash and MAC algorithms, and digital signatures.
5.	Design network application security schemes, such as PGP, S/ MIME, IPSec, SSL, TLS, HTTPS, SSH, etc.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		3	2				2	3	
2	3		3	2				2		2
3	2		1	2				2		2
4	3		1	1				2		1
5	3			1				2		1

TEXT BOOKS:

1. William Stallings, Cryptography and Network Security, Third Edition, Pearson Education,2003.

REFERENCE BOOKS:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication In a Public World, Second Edition, Pearson Education Asia,2002.

CLOUD COMPUTING

Course Code:	**23CSE131**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**0+3+0+0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1. To learn the components of cloud computing and storage networking technologies.
2. To comprehend the concepts of virtualization.
3. To understand the different types of virtualization.
4. To learn about the characteristics of cloud computing and cloud infrastructure and management of the cloud

UNIT-I

Classic data center and its elements, Challenges and benefits.Virtualization of compute,storage and network. Definition of cloud computing. Steps in transitioning to cloud- consolidation, automation,IT as a service. Compute – Physical and logical components. Storage –Media and options, RAID and concept ofLUN.Network– Physical components and Protocols Storage networking technologies- DAS, FC SAN, IP SAN, FCoE, NAS, Object based storage.Business continuity–Need,Terminologies,solutions.Backup and Recovery –Overview,methods,components and operation, Data	**15 Hours**

deduplication. Replication- Overview, consistency, local and remote replication technologies, Data center management.	
Compute Virtualization – Challenges of x86 hardware virtualization, Hypervisor- Type 1 and Full, para and hardware assisted virtualization. Virtual machine,VM disk files BIOS files and swap files,virtual machine hardware-CPU, memory, disk, networkinterface another devices. Resource Management.VMFS, Physicaland virtual machine conversion-benefits,options process	
UNIT-II	
Storage virtualization – LVM, NAS volume management- AVM, storage pool, Block and file level virtualization,Thin provisioning and automated storage tiering Network virtualization – Networking in VDC, Virtual NIC, Switch, router, VLAN and VSANtechnologies,VLASNtaggingmodes- VST,ESTandVGT.PrivateVLAN,Networktrafficmanagement,NIC teaming,NetworkI/Control,Multipathing. Application and Desktop virtualization - Application virtualization – different layers, user profile virtualization, application streaming and encapsulation, benefits. Desktop virtualization- methods –client based and computer based. Business continuity in Virtual Data center–Fault tolerance mechanism, clustering, protecting network. Backup inVDC–approaches,arraybasedbackupofVM,Image based backup,Deduplication in VDC, Replication and migration, host based and storage array based, VM migrationDriversforcloudcomputing,Gridandutility Computing,virtualization,SOA.	**15 Hours**
UNIT-III	

Characteristics of Cloud computing,Cloud service offering examples,economics of cloud computing–colocation, managed service provider and cloud.Cloud deployment models-public,private,hybrid and community cloud. Cloud Service models – Saas, Paas andIaas Examples. Cloud infrastructure and Management – Cloud infrastructure framework, Cloud OS, cloud services,security infrastructure, Stakeholders for cloud service – service provider, broker and consumer. Monitoring and management–service portfolio management,catalog management asset and configuration management, change management incident and availability management. Migration to cloud – Migrating the existing applications, Migration considerations- cost saving, interoperability, SLA and transparency, security and compliance	**10 Hours**

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

1.	Define the components of cloud computing and storage networking technologies.
2.	Illustrate the concepts of virtualization
3.	Comprehend the different types of virtualization
4.	Illustrate the characteristics of the cloud computing
5.	Demonstrate the management of cloud infrastructure

Program Outcomes→	1	2	3	4	5	6	7	8	PSO↓	
↓ Course Outcomes									1	2
1	3		3	3	3				2	
2	3		3	3	3				3	3
3	3		3	3	3				3	3
4	3		3	3	3				3	
5	3		3	3	3				3	3

TEXTBOOKS:

1. John Rittinghouse, Cloud computing – Implementation, management and security,CRCpress,1st edition, 2009.

2.	Joshy Joseph & Craig Fellenstein,GridComputing,IBMPress,2007.
3.	Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach,TataMcGraw-Hill, 2009.
4.	Prabhu,GridandClusterComputing,Prentice-HallofIndia,2007.
REFERENCE BOOKS:	
1.	Dan C Marinescu,Cloud Computing Theory and Practice ,Elsevier (MK) 2013.

BUSINESS INTELLIGENCE

Course Code:	**23CSE132**	**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**

Course Objectives:

1.	Identify various sources of data and identify the methods to process them.
2.	Explain the ETL process and carry out the ETL process for a given data set.
3.	Design a suitable schema for a given problem.
4.	Illustrate the concepts of data mining and Demonstrate the Classification and clustering methods.

UNIT-I

INTRODUCTION TO BUSINESS INTELLIGENCE:Types of digital data – Structured, semi structured and unstructured – sources, characterizes, challenges; Introduction to OLTP, OLAP and Data Mining; BI Definitions & Concepts; BI Framework, Who is BI for, BI Users, BI Applications;BI Roles & Responsibilities, Need for data warehouse – definition, data mart, Approaches for data warehouse, ETL(Extraction Transformation Loading) **Basics of Data Integration**: Concepts of data integration; Need and advantages of using data integration; Introduction to common data integration approaches; **Introduction to data quality**: data profiling concepts and applications, Introduction to SSIS Architecture, Introduction to ETL using SSIS tool.	**15 Hours**

UNIT-II

A Multidimensional Data Model - Concepts of dimensions, facts, cubes, attributes, hierarchies, star and snowflake schema; Data Warehouse Architecture. Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multidimensional modeling; **Introduction to business metrics and KPIs**- Measure, metrics, KPIs and performance management, salient attributes of a good metric, SMART test. **Introduction to enterprise reporting** – perspectives, standardization and presentation, balanced scorecards. Concepts of dashboards- types, steps, Applications of Data mining and Case studies of BI.	
	15 Hours
UNIT-III	
Data Mining—On What Kind of Data? Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Mining Association rules: Basic concepts, frequent itemset mining methods. **Classification And Prediction**: Issues regarding Classification and Prediction, classification by Decision tree induction, Bayesian classification, prediction. **Cluster Analysis** -What is Cluster Analysis? Types of data in cluster Analysis, Partitioning Methods, hierarchical clustering Methods.	**10 Hours**

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

1.	Identify the sources of data based on its type for a business application and apply OLTP, OLAP operations.
2.	Apply the knowledge of BI operation to determine various roles in a BI application and design the ETL process for handling the data from a given application.
3.	Relate the data warehousing concepts for a real time business application to model a star, snowflake schema for a multi-dimensional data of a given problem.
4.	Explain data quality and profiling methods, identify the quality of the data using data profiling techniques. Apply the measures and metrics to the data to design an enterprise report.
5.	Apply the concepts of mathematics and computer algorithm to illustrate the data mining concepts using association rules.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2	2				2	2	2
2	3		2	2				2	2	2
3	3		2	2	2			2	3	3
4	3		2					2	2	2
5	3		2	2	2			2	3	3

TEXTBOOKS:

1. RN Prasadand Seema Acharya "Fundamentals of Business Analytics",Wiley-India,2011
2. Larissa T Moss and ShakuAtre – Business Intelligence Roadmap: The Complete Project Life cycle for Decision Support Applications, Addison Wesley Information TechnologySeries,2003.
3. Jiawei Hanand Micheline Kamber, "Data Mining:Concepts and Techniques",Morgan Kaufmann Publishers, 2000 (ISBN: 1-55860-489-8).

BIG DATA ANALYTICS

Course Code:	**23CSE133**	**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**

Course Objectives:

1. Study and comprehend in depth the fundamental issues behind the Big Data problem.
2. Understand various Big Data technologies and different NoSQL databases. Learn MongoDB NoSQL database.
3. Understand various Big Data technologies and Hadoop Components such as HDFS,MapReduce. Learn MapReduce Programming
4. Determine various techniques for analyzing the data such as Spark,Pig and Hive.

UNIT-I

Introduction to Big Data: Types of digital Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What Is Big Data? Why Big data? Traditional BI versus Big data.Big Data Analytics: What is Big Data Analytics? Why this sudden Hype around Big Data analytics? Data Science, Terminologies used in Big Data environments **Introduction to NoSQL**: Where it is used, Types of NoSQL databases, Why NoSQL, Advantages of NoSQL, **Introduction to MongoDB**: What is MongoDB? Why MongoDB? Using JSON, Creating or generating a unique key, Data types in MongoDB, MongoDB Query Language: Insert method, Save method, Update method, Remove method, Find method, Dealing with Null values, Count, Limit, Sort, Skip.	**15 Hours**
UNIT-II	
Introduction to Hadoop : Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop , Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System) , Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator). **Writing Hadoop MapReduce Programs**: Understanding the basics of MapReduce, Introducing Hadoop MapReduce,Understanding the different Java concepts used in Hadoop programming, Writing a Hadoop MapReduce example, Understanding several possible MapReduce definitions to solve business problems. **SPARK:** Spark applications, Jobs, stages and Tasks, Resilient Distributed Datasets(RDD), Anatomy of SPARK Job Run; SPARK on YARN	**15 Hours**
UNIT-III	
Hadoop Ecosystem: Understanding Hadoop subprojects: Mahout, Apache HBase, Hive, Pig, Apache Sqoop, Apache Zookeeper, Apache Solr, Ambari. **HBase:** What is HBase? Storage Mechanism in HBase, Features of HBase, HBase and RDBMS, HBase and HDFS. **Introduction to Pig**: What is Pig? Pig on Hadoop, Pig Philosophy, Pig Latin overview; Pig Data Types; Running Modes of Pig; Execution Modes of PIG, Relational operators, EVAL function, Complex data types. **Introduction to Hive**: What is Hive? Architecture; HIVE Data Types; HIVE File	**10 Hours**

Format; Hive Query Language(HQL).	

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

1.	Outline the theory of big data, and explain applications of big data.
2.	Get the idea of NoSQL databases, different types of NoSQL datastores.
3.	Analyse the technological foundations for Big data with hadoop and design of hadoop distributed file system.
4.	Understand the concept of MapReduce programmig and Spark workflow.
5.	Understand the need of Big Data Analytics and Analyze Hadoop Ecosystem

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2					2	1	1
2	3		2		2			2	1	1
3	3		2	2	2			2	2	2
4	3		2	2	2			2	3	3
5	3		2		2			2	1	1

TEXTBOOKS:

1.	SeemaAcharya, SubhashiniChellappan, "Big Data Analytics", 1st Edition, Wiley, 2015.
2.	Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing 2013.
3.	Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilley, 2012.

REFERENCE BOOKS:

1.	V1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2.	Chris Eaton, Dirk derooset al., "Understanding Big data ", McGraw Hill, 2012.
3.	E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, O'Reilley, 2012.
4.	Lars George, HBase: The Definitive Guide, O'Reilley, 2011.
5.	Alan Gates, Programming Pig, O'Reilley, 2011

E Books / MOOCs/ NPTEL

1.	https://www.upgrad.com/big-data-analytics-

2.	https://www.coursera.org/courses?query=big%20data%20analytics.
3.	https://www.edx.org/micromasters/big-data

SOCIAL AND WEB ANALYTICS

Course Code:	**23CSE134**	**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**

Course Objectives:

1.	To understand social media, web and social media analytics, and their potential impact.
2.	To model and visualize the social network.
3.	To understand the evolution of the social network.
4.	To mine the interest of the user.

UNIT-I

Introduction to Web and Social Analytic: Overview of web & social media (Web sites, web apps, mobile apps and social media), Impact of social media on business, Social media environment, , How to leverage social media for better services, Usability,user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages. Introduction- Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks. Need of using analytics, Web analytics technical requirements., current analytics platforms, OpenSources licensed platform,choosing right specifications &	**15 Hours**
optimal solution,Web analytics and a Web Analytics 2.0 framework, Data Mining, Data Mining Techniques-Association,Classification, Clustering.	

UNIT-II

Data Modeling and Mining Communities Data (Structured data, unstructured data, metadata, Big Data and Linked Data), Modeling And Visualization- Visualizing Online Social Networks - A Taxonomy of 26 Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships. Mining Communities- Aggregating and reasoning with social network data- Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks	**15 Hours**
UNIT-III	
Text and Opinion Mining- Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time. Tools for Social Network Analysis- UCINET – PAJEK – ETDRAW – StOCNET – Splus – R – NodeXL – SIENA and RSIENA – Real world Social Networks (Facebook- Twitter Etc.)	**10 Hours**
Course Outcomes: At the end of the course student will be able to	

1.	Understand social media, web and social media analytics, and their potential impact.
2.	Identify the need of using analytics and explain data mining techniques.
3.	Recognize types of data and visualize the social network.
4.	Determine the evolution of social networks.
5.	Explain text mining and mine the opinion of the user.

Program Outcomes→	1	2	3	4	5	6	7	8	PSO↓	
↓ Course Outcomes									1	2

1	2	3					2	2		1
2	3	3		1				2	2	1
3	2	3						2		3
4	3	3						2		2
5	2	3	2	1		2		2	2	3

TEXTBOOKS:

1.	MatthewA.Russell, Mining Social web,O'Reilly;2 edition, 2013, ISBN-13:978-1449367619.
2.	Charu C Aggarwal,SocialNetworkDataAnalytics,Springer;2014,978-1489988935
3.	Peter Mika, "Social Networks and the Semantic Web", 1 st edition, Springer, 2007.
4.	BorkoFurht, "Handbook of Social Network Technologies and Applications", 1st edition, Springer, 2010.

REFERENCE BOOKS:

1.	Hand, Mannila, and Smyth. Principles of Data Mining. Cambridge, MA: MIT Press, 2001.ISBN:026208290X.
2.	Avinash Kaushik,Web Analytics2.0:The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons; Pap/Cdr Edition, 2009.
3.	GuandongXu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", 1st edition, Springer, 2011.
4.	Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
5.	Ajith Abraham, Aboul Ella Hassanien, VáclavSnáel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
6.	Toby Segaran, "Programming Collective Intelligence'', O' Reilly, 2012. 8. Sule Gündüz-Öğüdücü, A. Şima Etaner-Uyar, "Social Networks: Analysis and Case Studies'', Springer, 2014.
7.	Hand, Mannila, and Smyth," Principles of Data Mining", Cambridge, MA: MIT Press, ISBN: 026208290X, 2001.

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc20_cs78/preview
2.	https://www.coursera.org/learn/social-media-data-analytics
3.	https://www.coursera.org/learn/text-mining

PARALLEL COMPUTING ARCHITECTURE

Course Code:	**23CSE201**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4+0+0+0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	Know the principles of computer design and way in which arithmetic operations are carried out in a processor
2.	Understand the concepts like instruction scheduling (dynamic and static), branch prediction, out-of-order execution with respect to pipelined and superscalar processors.
3.	Comprehend various Cache optimization techniques and discuss the hardware and software support for VLIW and EPIC systems.
4.	Identify the concepts of High Performance Computing, Distributed-Memory Parallelism and Shared-Memory Parallelism.

UNIT-I	
Fundamentals of Computer Design: Introduction, Classes of Computers, Measuring, reporting and summarizing performance, quantitative principles of computer design. **Computer Arithmetic:** Introduction, Basic Techniques of Integer Arithmetic, Floating Point: Floating-Point Multiplication, Floating-Point Addition, Division and Remainder.	**10 Hours**
UNIT-II	
Instruction Level Parallelism, Its Exploitation and Limits on ILP: Introduction To Pipelining, the major hurdle of pipelining-pipeline hazards, How is pipelining implemented.	
ILP and its exploitation: Concepts and Challenges, Basic compiler techniques for exposing ILP, Reducing branch cost with prediction, overcoming data hazards with dynamic scheduling, hardware based speculation, exploiting ILP using multiple issues and static scheduling, exploiting ILP using Dynamic scheduling, multiple issue and speculation, advanced techniques for instruction delivery and speculation. Case study of Pentium 4.Introduction to limits on ILP	**10 Hours**
UNIT-III	

Title: Memory Hierarchy Design, Storage Systems: Review of basic concepts; Cross cutting issues in the design of memory hierarchies; Case study of AMD Opteron memory hierarchy. **Hardware and Software for VLIW and EPIC: Introduction:** Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor.	**10Hours**
UNIT-IV	
Introduction to High Performance Computing: What is high performance computing? -Motivation, Applications,Challenges. **HPC Computer architecture models:** SIMD, MIMD,SPMD; **HPC Communication models:** Shared Address Space vs. Message Passing. **Distributed-Memory Parallelism:** Parallel Algorithm Design, Parallel Programming with MPI, The Message Passing Programming Model, blocking vs. Non-blocking communications, MPI program Anatomy & communicators, MPI program to Parallel Matrix Multiplication	**10 Hours**
UNIT-V	
Shared-Memory Parallelism: Basic Patterns in Pthreads, Mutual Exclusion in Pthreads, Basic Patterns in OpenMP, Mutual Exclusion in OpenMP. **Hybrids and Accelerators:** Hybrid Architectures, MPI+ OpenMP - Use MPI and OpenMP in the same application, Introduction to GPGPU computing with CUDA, Coprocessors - Overview of Intel's Xeon Phi architecture, introduction to programming Intel's XeonPhi.	**10 Hours**
Course Outcomes: At the end of the course student will be able to	

1.	Comprehend the fundamental principles of computer design and topics of computer arithmetic.
2.	Knowledge of Instruction level parallelism, hurdles in ILP, and techniques to

	exploit ILP.
3.	Analyze various techniques to improve cache performance and Identify the hardware and software needed for VLIW and EPIC architecture.
4.	Identify and explore the concepts of high performance computing and distributed memory parallelism.
5.	Realize the shared memory parallelism and GPU programming

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2		3	3	3			2	3	
2	2		3	2	2			2	2	
3	2		3	2	2			2	2	
4	3		2	3	3			2	3	2
5	3		2	3	3			2	3	2

TEXTBOOKS:

1	JohnL.HennesseyandDavidA.Patterson, ComputerArchitecture, A Quantitative Approach, 4th Edition, Elsevier, 2007.
2	Niranjan N. Chiplunkar and Raju K., Introduction to Parallel Computing. Wiley India,2020.
3	Michael J.Quinn, Parallel Programming in C with MPI and OpenMP ,McGraw-HillHigher Education 2003.
4	JasonSandersandEdwardKandrot,CUDAbyExample:An Introduction to General-PurposeGPU Programming, 2010.

REFERENCE BOOKS:

1.	AnanthGrama,Introduction to parallel computing, Addison-Wesley 2nded.,2003.
2.	VictorEijkhout,IntroductiontoHigh-PerformanceScientificComputing,2011.
3.	http://web.stanford.edu/class/cme213/lecture.html: MPI,OpenMP,CUDAandXeonPhiprogramming.

OPERATING SYSTEMS AND VIRTUALIZATION

Course Code:	**23CSE202**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4+0+0+0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	To introduces Virtualization, operating systems fundamental concepts and its technologies
2.	To provides skills to write programs that interact with operating systems components such as Processes, Thread, Memory during concurrent execution
3.	To provide the skills and knowledge necessary to implement, provisioning and administer server and desktop virtualization

UNIT-I	
Computer system architecture a layered view with interfaces – Glenford Myer, Monolithic Linux Hybrid Windows10 kernels Layered architecture of operating system and core functionalities, Process Operations, States, Context switching, Data Structures (Process Control Block(PCB), Process Scheduling: Multilevel Feedback Queue, Multiprocessor Scheduling, Deadlocks and its detection	**10 Hours**
UNIT-II	
Memory - Introduction, Address Spaces, Memory API, Address Translation, Paging-Faster Translations (TLB), Smaller Tables. Virtual Memory System inx86 Concurrency - Introduction, Thread Models, Thread API, Building Evaluating a Lock, Test And Set, Two phase lock, Classical problems handling using semaphore. Persistence- File Organization: The i-node, Crash Consistency, file security.	**10 Hours**
UNIT-III	
Virtual Machines - Process and System VMs Taxonomy of VMs, Types of Virtualization, Hardware Emulation, Full Virtualization with binary translation, Hardware assisted, Operating System Virtualization, OS assisted /Para virtualization.	**10 Hours**
UNIT-IV	
Mass storage structures: storage device management, swap-space management. Implementing file system: file system concepts, file system structure and operations., Hypervisor - Type 1, Type 2, Para virtualization, Server Virtualization, Desktop Virtualization.	**10 Hours**
UNIT-V	

Security: Program threats, System and network threats. Protection: Principles of protection, role based access control, Mandatory access control. Overview VM portability- Clones, Templates, Snapshots, OVF, Hot And Cold Cloning Protecting Increasing Availability, LightWeight Virtual machine: Container /Docker.

10 Hours

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

1.	Study operating system layers and kernel architectures
2.	Design various techniques for process management
3.	Construct various address translation mechanism
4.	Perform process threading and synchronization
5.	Study various methods of virtualization and perform desktop and server virtualization
6.	Classify the light-weight virtual machines with dockers and containers
7.	Develop programs related to the simulations of operating systems and virtualization concepts

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	3	1				1	3	1	1
2	3	3				1		3		1
3	3	3	2					2	2	
4	3	3		2				3	2	
5	3	3	2	2	2			3	1	3

TEXTBOOKS:

1.	Thomas Anderson, Michael Dahlin, Operating Systems: Principles and Practice, Second Edition, Recursive Books,2014
2.	Matthew Portnoy, Virtualization Essentials, John Wiley Sons Inc; 2nd Edition, 2016
3.	

REFERENCE BOOKS:

1.	William Stallings, Operating Systems: Internals and Design Principles, 8thEdition
2.	A.Silberschatz and P.Galvin. Operating System Concepts. Eight Edition, John Wiley Sons, 2008
3.	Smith, Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Morgan Kaufmann Publishers(2005)

Parallel Computing Lab

Course Code:	**23CSE203**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0+0+2+0**	**Credits:**	**01**
Total Teaching Hours:	**2**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	To develop OpenMP programs.
2.	To develop MPI programs.
3.	To develop CUDA programs.
4.	To profile parallel programs.

List of Experiments

1.	OpenMP Sample Programs Time estimation
2.	Develop a sample program using Execution Environment Routines and write interesting observations by comparing various routines
3.	Develop a program using following construct and describe scenario for the need of construct Parallel Construct
4.	Determining the Number of Threads for a parallel Region Work-sharing Constructs
5.	Loop construct Sections construct Single construct Schedule clause Static Dynamic Guided
6.	Data Environment Constructs Shared Clause Critical Construct Reduction Clause Master Construct No Wait Clause Barrier Construct Atomic Construct
7.	Analysis through any one of profiling tools (ITAC/VTune/EEP/IIP) Experimental setup
8.	Parallelizing given serial program into parallel
9.	Analyzing parallel programs
10.	CUDA programming
11.	Write a CUDA C/C++ program that add two array of elements and store the result in third array
12.	How to Reverse Single Block in an Array using CUDA C/C++
13.	CUDA C program for Matrix addition and Multiplication using Shared memory
14.	Write CUDA C/C++ program for Vector Addition. Modify your program so that it can add two vector of arbitrary size

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

1.	Develop shared memory parallel programs using OpenMP directives.
2.	Develop distributed memory parallel programs using MPI APIs.
3.	Develop GPU parallel programs using CUDA-C APIs.
4.	Profile parallel programs using VTune
5.	Analyze parallel programs

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	2	2	3	3	2		2	3	2
2	2	2	2	3	3	2		2	3	2
3	2	2	2	3	3	2		2	3	2
4	2	2	2	3	3	2		2	3	2
5	2	2	2	3	3	2		2	3	2

REFERENCE BOOKS:

1.	Niranjan N. Chiplunkar and Raju K., Introduction to Parallel Computing. Wiley India,2020.
2	David Kirk and Wen-Mei W.Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2010.
3	Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, 2010.

E Resources

1.	http://web.stanford.edu/class/cme213/lecture.html: MPI, OpenMP, CUDA and Xeon Phi programming.
2	Introduction to MPI (SHARCNET). Online: https://www.youtube.com/watch?v=RoQJNx5npF4
3	Introduction to MPI programming, by Hristo Iliev, HPC Group, RWTH Aachen University. Online: https://www.youtube.com/channel/UCtdrEoe46tD2IvJJRs_JH1A/videos
4	Introduction to OpenMP - Tim Mattson (Intel). Online: https://www.youtube.com/playlist?list=PLLX-Q6B8xqZ8n8bwjGdzBJ25X2utwnoEG
5	CUDA Training Resources by NVIDIA. Online: https://developer.nvidia.com/educators/existing-courses

Operating Systems and Virtualization Lab

Course Code:	**23CSE204**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0+0+2+0**	**Credits:**	**01**
Total Teaching Hours:	**2**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	To study basics of linux commands and execution of shell scripts.
2.	To study various scheduling algorithms and bankers algorithms.
3.	To analyse various dynamic memory allocation algorithms.
4.	To implement various page replacement algorithms.

List of Experiments

1.	Study of Basic Linux Commands
2.	Shell Programming (I/O, Decision making, Looping, Multi-level branching)
3.	Creating child process using fork() system call, Orphan and Zombie process creation
4.	Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin)
5.	Simulation of Banker's algorithm to check whether a given system is in safe state or not. Also check whether addition resource requested can be granted immediately
6.	Parallel Thread management using pthread library. Implement a data parallelism using multi-threading
7.	Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms
8.	Page Replacement Algorithms FIFO, LRU and Optimal
9.	Virtualization Setup: Type-1, Type-2 Hypervisor
10.	Implementation of OS / Server Virtualization

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

1.	Study various shell scripts and command usage.
2.	Design various scheduling algorithms.
3.	Construct memory allocation algorithms based on first fit, best fit and worst fit algorithms.
4.	Develop various page replacement algorithms.
5.	

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	3	1				1	3	1	1
2	3	3	1			1		3		1
3	3	3	2	2				3	2	
4	3	3		2				3	2	

RESEARCH EXPERIENCE THROUGH PRACTICE -2			
Course Code:	**23CSE205**	**Course Type**	**RETP**
Teaching Hours/Week (L: T: P: S)	**0:0:4:0**	**Credits**	**2**
Total Teaching Hours	**52**	**CIE**	**100**

Teaching Department:

Course Objectives: The research purposes are

- To foresee future problems through pursuit of truth as a "global centre of excellence for intellectual creativity".
- To respond to current social demands, and to contribute to the creation and development of scientific technologies with the aim of realizing an affluent society and natural environment for humanity.
- At the same time, the course aims to create excellent educational resources and an excellent educational environment through frontline research.
- To Understand professional writing and communication contexts and genres, analyzing quantifiable data discovered by researching, and constructing finished professional workplace documents.

The students are expected to carry out Mathematical modeling/Design calculations/computer simulations/Preliminary experimentation/testing of the research problems identified during Research Experience through Practice-I carried out in the first semester.

At the end of the second semester, students are expected to submit a full research paper based on the Mathematical modelling/ Design calculations/computer simulations/Preliminary experimentation/testing carried out during second semester.

The research paper prepared based on the work carried out by the PG Student is evaluated for 50 marks and 20 minutes presentation on the research work carried out will be evaluated

for 50marks jointly by the examiners.

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

1.	Create a model/prototype through fabrication, simulation, data analysis, Experimentation for the proposed problem.
2.	Analyse and validate the results obtained.
3.	Compose a technical paper as per the given format.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3	2							3	2
2	3	2			3				2	
3	3	2						3		1

REFERENCE BOOKS:

1. The Undergraduate Research Hand book. Gina Wisker · 2018

DISTRIBUTED OPERATING SYSTEM

Course Code:	**23CSE211**	**Course Type:**	
Teaching Hours/Week (L: T: P: S):	**3+0+0+0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	To understand the concept of a distributed operating system.
2.	To know about the distributed file system and shared memory.
3.	To understand the security issues in distributed systems.
4.	To make a case study of some real time systems.

UNIT-I

Distributed System management: Introduction, Resource management, Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach, Process management in a Distributed Environment, Process Migration, Threads, Fault Tolerance. **Distributed Shared Memory:** Introduction, Basic Concepts of DSM, Hardware DSM, Design Issue in DSM Systems, Issue in Implementing DSM Systems, Heterogeneous and other DSM Systems, Case Studies.	**15 Hours**

UNIT-II

Distributed File System: Introduction to DFS, File Models, Distributed File System Design, Semantics of File Sharing, DFS Implementation, File Caching in DFS, Replication in DFS, Case studies. Naming: Introduction, Desirable	**15Hours**
features of a good naming system, Basic concepts, System- oriented names, Object-locating mechanisms, Issues in designing human-oriented names, Name caches, Naming and security, Case study:Domain name service.	
UNIT-III	
Security in distributed systems: Introduction, Cryptography, Secure channels, Access control, Security Management, Case studies **Real-Time Distributed Operating Systems:** Introduction, Design issues in real-time distributed systems, Realtime communication, Real- time scheduling, Case study: Real-time communication in MAR.	**10 Hours**

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

1.	Explain the DS concepts.
2.	Explain the working of distributed shared memory.
3.	Demonstrate the application of a distributed file system.
4.	Explain the security issues in distributed systems.
5.	Make a case study of distributed systems.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		3	3	3				3	
2	3		3	3	3				3	
3	3		3	3	3				3	
4	3		3	3	3				3	
5	3		3	3	3				3	

TEXTBOOKS:

1.	Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.

REFERENCE BOOKS:

1.	Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013.

DEEP LEARNING

Course Code:	**23CSE212**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3 Hours**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Understand the context of neural networks and deep learning
2.	Understand the data needs of deep learning
3.	Have a working knowledge of neural networks and deep learning
4.	Explore the parameters for neural networks

UNIT-I

Introduction: What is Deep Learning? What are Neural Networks? Neural networks basics: cost functions, hypotheses and tasks; training data; maximum likelihood-based cost, cross entropy, MSE cost; feed-forward networks; MLP, sigmoid units; neuroscience inspiration;	**15 Hours**
Neural Networks Training: Learning in neural network: output vs hidden layers; linear vs nonlinear networks; Backpropagation: learning via gradient descent; recursive chain rule (backpropagation); if time: bias-variance tradeoff, regularization; output units: linear, softmax; hidden units: tanh, RELU; Deep learning strategies: GPU training, regularization, RLUs, dropout.	

UNIT-II

Convolution Neural Networks: Invariance, stability, Variability models (deformation model, stochastic model), Scattering networks, Group Formalism, Properties of CNN representations: invertibility, stability, invariance, covariance/invariance: capsules and related models, Connections with other models: dictionary learning, LISTA, localization, regression, Embeddings (DrLim), inverse problems, Extensions to non-Euclidean domains.	**15 Hours**

UNIT-III

Deep Neural Networks for Sequences: Recurrent Neural Networks: RNN for language modelling and other tasks, GRUs and LSTMs -- for machine translation, LSTM, GRU	**10 Hours**

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

1.	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2.	Implement deep learning algorithms and solve real-world problems.
3.	Execute performance metrics of Deep Learning Techniques.
4.	Explore the parameters for neural networks.
5.	Apply the CNN and RNN for solving the engineering problems.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3								3	
2			3	2					3	3
3	3		2		3					3
4	3		2							3
5	3	1	2	2	3					3

TEXTBOOKS:

1.	Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, The MIT Press, 2016.

REFERENCE BOOKS:

1.	Duda, R.O., Hart, P.E., and Stork, D.G. , Pattern Classification, Wiley-Interscience. 2nd Edition. 2001.
2.	Theodoridis, S. and Koutroumbas, K., Pattern Recognition. Edition 4, Academic Press, 2008.
3.	Russell, S. and Norvig, N, Artificial Intelligence: A Modern Approach, Prentice Hall Series in Artificial Intelligence. 2003.
4.	Bishop, C. M., Neural Networks for Pattern Recognition, Oxford University Press. 1995.
5.	Hastie, T., Tibshirani, R. and Friedman, J., The Elements of Statistical Learning, Springer. 2001.

E Books / MOOCs/ NPTEL

1.	http://cs224d.stanford.edu/syllabus.html https://www.cs.colorado.edu/~mozer/Teaching/syllabi/DeepLearningFall2017

OBJECT ORIENTED DESIGN

Course Code:	23CSE213	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3 Hours	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Course Objectives:

1.	Identify the heuristics of the object-oriented programming
2.	Explain the fundamentals of OOP
3.	Examine fine object-oriented relations
4.	Explain the role of Physical Object-Oriented Design,
5.	Make use of Heuristics in The Use of Heuristics in Object-Oriented Design

UNIT-I	
The Motivation for Object-Oriented Programming, Classes and Objects: The Building Blocks of the Object-Oriented Paradigm, Topologies of Action-Oriented Versus Object-Oriented Applications, The Relationships Between Classes and Objects the Inheritance Relationship	**15 Hours**
UNIT-II	
Multiple Inheritance, The Association Relationship, Class-Specific Data and Behavior, Physical Object-Oriented Design.	**15 Hours**
UNIT-III	
The Relationship Between Heuristics and Patterns, The Use of Heuristics in Object-Oriented Design	**10 Hours**

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

1.	Identify and make use of the heuristics in object-oriented programming.
2.	To explain the fundamentals of OOP and the role of Physical object oriented design.
3.	To examine the object-oriented relations between heuristics and patterns.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	1	1			2		1	1	1
2	3	2	1			2		1	1	1
3	3	2	1			2		1	1	1

TEXTBOOKS:

1.	Object Oriented Design Heuristics, Arthur J Riel, Addison-Wesley 1996.

REFERENCE BOOKS:

1.	Elements of Reusable Object- Oriented Software
2.	John Vlissides Pearson Object - Oriented Modeling and Design with UM Paperback, Michael R. Blaha)

DISTRIBUTED SYSTEMS

Course Code:	**23CSE214**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3 Hours**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	To learn the principles, architectures, algorithms and programming models used in distributed systems.
2.	To examine state-of-the-art distributed systems, such as Google File System.
3.	To design and implement sample distributed systems.

UNIT-I

Overview of distributed system – examples of distributed systems: client - server architecture – WWW peer to peer – Napster –Bit torrent - mobile and ubiquitous computing –System Model: Physical model – architectural model – fundamental models External data representation- marshalling – un-marshalling- Message passing- group communication: Publish-subscribe system – message queues – shared memory approach. Remote procedure call – distributed objects-communication between distributed objects – RMI – JSON-RMI Process – Events- states – partial and total ordering – Synchronizing- physical clock synchronization- Christians algorithm- Berkeley algorithm – NTP – logical clocks – scalar and vector clock – lamport logical clock for partial and total ordering – consistent cut – inconsistent cut – global states – lamport global snapshot algorithm.	**15Hours**

UNIT-II

Distributed deadlock – Resource allocation model - requirements and performance metrics - classification of distributed deadlock detection algorithm – Lamport - Haas- Misra Edge chasing distributed deadlock detection algorithm. Distributed Mutual exclusion – requirements and performance metrics of distributed mutual exclusion algorithm- Distributed mutual exclusion algorithm: token based –Raymond tree algorithm– quorum based : mekawa' svoting algorithm message based – Ricart Agrawala algorithm – Election – ring based election – bully election algorithm – Multicast communication.	**15 Hours**
UNIT-III	
Optimistic and pessimistic transactions -Two – phase commit protocol – three phase commit protocol – Transaction recovery - Replication – fault tolerant services- the gossip architecture- Name services: DNS – Directory Services: X.500 protocol – Distributed file System –File service Architecture- NFS - GFS –Distributed locking mechanism- Distributed shared memory – Sequential and Release consistency	**10 Hours**

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

1.	Identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
2.	Examine how existing systems have applied the concepts of distributed systems in designing large systems.
3.	Apply these concepts to develop sample systems.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3	2	1					1	2	2
2	3	1	1					1	2	2
3	3	2	2					1	2	2

TEXTBOOKS:

1.	Randy Chow and Theodore Johnson, "Distributed Operating Systems and Algorithms" , Addison - Wesley, - Fourth Impression - 2012.

REFERENCE BOOKS:

1.	G. Coulouris, J. Dollimore , and T. Kindberg , "Distributed Systems : Concepts and Designs", 5th edition, Addison Wesley, 2011.
2.	Mukesh singhal and N.G. Shivaratri , "Advanced Concept sin Operating Systems, Distributed, Database, and Multiprocessor Operating Systems ", 1st edition, McGraw Hill, 1994.
3.	Vijay K. Garg, "Elements of Distributed Computing ", 1st edition, Wiley & Sons, 2002.

ADVANCED SOFTWARE TESTING

Course Code:	**23CSE221**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3 Hours**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	To Explain the overview of testing technique and create test plans , test Cases and test Scenarios
2.	To Generate test Scripts, test requirements specification and test plan for given project
3.	To Illustrate the use of functional testing , non functional testing and develop test cases in object-oriented testing
4.	To Make use of various modern engineering testing tools and techniques for automation testing
5.	To Evaluate the software quality using empirical software testing process

UNIT-I

Overview of Testing Techniques–Creating Test Plans and Test Cases – Test Scenarios – Test Data – Test Scripts, Test Requirements Specification and gathering – Creating TRS and Test Procedure Pre-Planning Activities: Success Criteria/Acceptance Criteria, Test Objectives, Assumptions, Entrance Criteria/Exit Criteria Test Planning: Test Plan, Requirements/Traceability, Estimating, Scheduling, Staffing, Approach, Test Check Procedures	**15 Hours**

Post-Planning Activities: Change Management, Versioning (change control/change management / configuration management) Software Test Management : Risk and Testing - Test Organization – Test progress monitoring and control.	
UNIT-II	
Functional Testing: Automated Unit Testing – Test Plan & Scripts – Creating Automated Test Procedures and Reports – Integration Testing – Order of Integration – Creating & Maintaining Tested Databases- Test Metrics Non-Functional Testing : Performance Testing – Load Testing – Endurance Testing – Scalability Testing –Internationalization Testing– Performance Analysis and Reporting , Developing Test Cases in Object-oriented Testing - Object-oriented Testing Methods: Fault-based Testing, Scenario based Testing – Challenges. Creating an environment supportive of software testing – Building Software Testing Process – Selecting and Installing Software Testing Tools – Building Software Tester Competency.	**15 Hours**
UNIT-III	
Automated Testing Tools – Functional Testing - Rational Functional Tester – Selenium – Cucumber - JUnit, Performance Testing Tools - Rational Performance Tester – HP Loadrunner, Test Management Tools - Quality Center, Performance Center Reports and Control Issues – Types of Review – Component of Review Plans – Reporting Review Results – Evaluation of Software Quality, Test Process Optimization, Empirical Software Testing and Analysis, Mobile Testing, SOA Testing , Data Warehouse Testing, Cloud Testing, BigData Testing, WebApps Testing, IoT Testing.	**10 Hours**
Course Outcomes: At the end of the course student will be able to	

1.	**Explain** the overview of testing technique and create test plans , test Cases and test Scenarios
2.	**Generate** test Scripts, test requirements specification and test plan for given project
3.	**Illustrate** the use of functional testing , non functional testing and develop test cases in object-oriented testing
4.	**Make** use of various modern engineering testing tools and techniques for automation testing

5.	**Evaluate** the software quality using empirical software testing process

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		3		2				2	
2	3		3		2				2	
3	3		3		3				2	
4	2		3		2				2	
5	2		3		2				2	

TEXTBOOKS:

1.	Srinivasan Desikan, Gopalaswamy Ramesh "Software Testing – Principles and practices ",Pearson Education, 2006
2.	Nick Jenkins "A Software Testing Primer – An Introduction to Software Testing" 2008. Scott W. Ambler "The Object Primer: Agile Model-Driven Development with UML 2.0" Third Edition, Cambridge University Press, March 2010.

REFERENCE BOOKS:

1.	"Software Testing – An ISTQB-BCS Certified Tester Foundation Guide" , Third Edition,BCS,2015

E Books / MOOCs/ NPTEL

1.	https://www.coursera.org/specializations/software-testing-automation
2.	https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3.	https://nptel.ac.in/courses/106105150

GENERAL PURPOSE COMPUTATION ON GPU

Course Code:	**23CSE222**	**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**

Course Objectives:

1.	Know the architecture of GPUs.
2.	Understand the execution and memory model of CUDA and OpenCL.
3.	Understand the Programming Model of CUDA and OpenCL.
4.	To write GPU programs on CUDA and OpenCL frameworks.

UNIT-I

Heterogeneous Architecture and Parallel Computing: Introduction to parallel programming, Introduction to heterogeneous architecture-GPU in particular. Introduction to GPU computing, Why GPU, evolution of GPU pipeline and general purpose computation on GPU, GPU architecture case studies:NVIDIA G80,GT200, Fermi, AMD Radeon, AMDFusion APU etc. Execution Model: Features CUDA and OpenCL, Comparison CUDA and OpenCL, Thread organization, Kernel, error handling, and execution in CUDA and OpenCL.	**16 Hours**
UNIT-II	
Programming Model: CUDA Introduction, basics of CUDA C, Complete CUDA structure, basic details of API and libraries, OpenCL overview, OpenCL basic specification, OpenCL C language, Vectorization. Memory Model: Introduction to memory model and GPU interaction with CPU, Memory model of CUDA and OpenCL, Memory Hierarchy (local/register, shared global) and optimizations, memory optimized programming, coding tips.	**14 Hours**
UNIT-III	
Tools And Programming: Introduction to installation and compilation process, usage of tools, profiler and debugger. CUDA by Examples and OpenCL by Examples, Future Directions.	**10 Hours**

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

1.	Explain the architecture of GPUs
2.	Describe the execution model of CUDA and OpenCL
3.	Illustrate the programming model of CUDA and OpenCL
4.	Explain the memory model of CUDA and OpenCL
5.	To develop GPU programs on CUDA and OpenCL frameworks

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3	2	2	3	3	2		2	3	2
2	3	2	2	3	3	2		2	3	2
3	3	2	2	3	3	2		2	3	2
4	3	2	2	3	3	2		2	3	2
5	3	2	2	3	3	2		2	3	2

TEXTBOOKS:

1.	David Kirk and Wen-Mei W.Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2010.
2.	Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General- Purpose GPU Programming, 2010.
3	Niranjan N. Chiplunkar and Raju K., Introduction to Parallel Computing. Wiley India,2020.
REFERENCE BOOKS:	
1.	T.Mattson,et al.Patterns Of ParallelProgramming,AddisonWesley,2005
2.	NVIDIACUDAProgrammingGuideV3.0,NVIDIA
3.	Benedict R. Gaster, Timothy G. Mattson and James Fung, OpenCL Programming GuidebyAaftabMunshi,2011.
4.	Benedict Gaster, David R. Kaeli, Lee Howes and Perhaad Mistry, HeterogeneousComputingwith OpenCL, 2011.
5.	GPUGems3,H. Nguyen(ed.),Addison Wesley, 2007.
6.	GPUGems 2,M. Pharr(ed.),Addison Wesley, 2005.
7.	NVIDIA and OpenCL:http://www.nvidia.com/content/cudazone/download/ OpenCL/NVIDIA_Open CL_Programming Guide.pdf
8.	http://www.nvidia.com/content/cudazone/CUDABrowser/do
9.	Open CL at Khronos:http://www.khronos.org/developers/library/overview/ opencl_overview.pdf http://www.khronos.org/registry/cl/specs/opencl-1.0.48.pdf
10	http://developer.amd.com/zones/OpenCLZone/courses/pages/Introduction-OpenCL Programming2010.
11	http://developer.amd.com/gpu/amdappsdk/documentation/pages/TutorialopenCL .aspx

ANALYSIS OF COMPUTER NETWORKS			
Course Code:	**23CSE223**	**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

Course Objectives:

1.	To understand and analyze the efficient usage available resources in transporting the voice packets.
2.	To understand the efficient sharing of the channel among the competing flow streams.
3.	To analyze the stream session in specific to deterministic network analysis.
4.	To analyze the stream session in specific to stochastic analysis.
5.	To understand the dynamic bandwidth sharing in elastic traffic.

UNIT-I	
Introduction: Two examples of analysis: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; The importance of quantitative modeling in the Engineering of Telecommunication Networks. **Multiplexing:** Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.	**15 Hours**
UNIT-II	
Stream Sessions: Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach. **Stream Sessions: Stochastic Analysis:** Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little' s theorem, Brumelle' s theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range-Dependent traffic.	**15 Hours**
UNIT-III	
Adaptive Bandwidth Sharing for Elastic Traffic: Elastic transfers in a Network; Network parameters and performance objectives; Sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet' s Adaptive Window Protocol; Bandwidth sharing in a Network.	**10 Hours**

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

1.	Explain and analyze the efficient usage available resources in transporting the voice packets.
2.	Illustrate the efficient sharing of the channel among the competing flow streams.
3.	Analyze the stream session in specific to deterministic network analysis.
4.	Analyze the stream session in specific to stochastic analysis.
5.	Explain the dynamic bandwidth sharing in elastic traffic.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2	2				3		3
2	3	2						2		3
3	3	2						2	2	
4	3		2					1	2	
5	3	2						1	1	

TEXTBOOKS:

1.	Anurag Kumar, D. Manjunath, Joy Kuri: Communication Networking and Analytical Approach, Elsevier, 2004.

REFERENCE BOOKS:

1.	M. Schwartz: Broadband Integrated Networks, Prentice Hall PTR, 1996.
2.	J. Walrand, P. Varaiya: High Performance Communication Networks, 2nd Edition, Morgan Kaufmann, 1999.

IMAGE PROCESSING AND ANALYSIS

Course Code:	**23CSE224**	**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**

Course Objectives:

1.	Explain the concept and steps included in Digital Image Processing. Describe Image Sampling and Image Quantization techniques and Apply the knowledge of 4-8 and M pixel adjacency to illustrate some basic relationships between pixels
2.	Explain Frequency domain, illustrate Smoothing Frequency-Domain Filters and Sharpening frequency-Domain Filters.
3.	Comprehend different methods, models for video processing and motion

	estimation
4.	Apply the process of image enhancement for optimal use of resources.

UNIT-I	
Image Basics Basic steps of Image processing system – Pixel relationship- Image Transforms-.Image Enhancement- Spatial filtering, Frequency Domain filtering – Image Segmentation – Image Compression. Binary object feature - Area, Centroid, Axis of Least Second Moment, Projections, Euler Number, Thinness Ratio, Eccentricity, Aspect Ratio, Moments, Boundary Descriptors - Chain Code, Freeman Code, and Shape Number, Signatures, Fourier Descriptors. Histogram-based (Statistical) Features, Intensity features- Hough transforms.	**15 Hours**
UNIT-II	
Concepts and classification: statistical, structural and spectral analysis, Co-occurrence matrices - Edge frequency - Multiscale texture description - wavelet domain approaches, Texture categorization and Texture segmentation. **Colour Image Processing** – Gray Level to Color Transformations Histogram Processing- Color Image Smoothing and Sharpening Color Noise Reduction Color-Based Image Segmentation Color Edge Detection Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template-Matching – based object recognition, Scene and Object Discrimination, Object Modelling, Model based object recognition	**15 Hours**
UNIT-III	
VIDEO PROCESSING: Basic Concepts and Terminology , Monochrome Analog Video, Analog Video Raster, Blanking Intervals, Synchronization Signals, Spectral Content of Composite Monochrome Analog Video, Color in Video , Analog Video Standards, NTSC, PAL, SECAM, HDTV, Digital Video Basics: Advantages of Digital Video, Parameters of a Digital Video Sequence, The Audio Component. **Analog-to-Digital Conversion** : Color Representation and Chroma Subsampling: Digital Video Formats and Standards, The Rec. 601 Digital Video Format, The Common Intermediate Format, The Source Intermediate	

Format,	
Video Compression Techniques and Standards, Video Compression Standards, Codecs, and Containers, Video Processing in MATLAB, Reading Video Files, Processing Video Files, Playing Video Files, Writing Video Files, Problems	**10 Hours**

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

1.	Explain the concept and steps included in Digital Image Processing. Describe Image Sampling and Image Quantization techniques and Apply the knowledge of 4-8 and M pixel adjacency to illustrate some basic relationships between pixels
2.	Explain Frequency domain, illustrate Smoothing Frequency-Domain Filters and Sharpening frequency-Domain Filters.
3.	Comprehend different methods, models for video processing and motion estimation
4.	Apply the process of image enhancement for optimal use of resources.

Program Outcomes→	1	2	3	4	5	6	7	8	PSO↓	
↓ Course Outcomes									1	2
1	3		2	2					3	2
2	3		2						3	2
3	2	2	2						2	3
4	2	3			3			2	2	3

TEXTBOOKS:

1.	Oge Marques, " Practical Image and Video Processing Using MATLAB", Wiley-IEEE, Press,2011
2.	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice- Hall, 2008.

REFERENCE BOOKS:

1.	Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding",

	Tsinghua University Press, 2009
2.	Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012
3.	Bogusław Cyganek," Object Detection and Recognition in Digital Images: Theory and Practice", Wiley, 2013
4.	Chanamallu Srinivasa Rao, Samayamantula Srinivas Kumar, "Content Based Image Retrieval Fundamentals & Algorithms - Basics, Concepts, and Novel Algorithms", Lap Lambert Academic Publishing, 2012

BLOCKCHAIN TECHNOLOGY

Course Code:	**23CSE231**	**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**

Course Objectives:

1.	Understand conceptual working of block chain technology
2.	Devise the block chain technology to innovate and improve business processes.
3.	Get the idea of working with Ethereum and Smart Contracts in Block Chain Environment.
4.	Solving real-world problems using Remix IDE and Truffle
5.	Describe and illustrate the idea of Hyperledger Fabric.

UNIT-I

Introduction: What Is the Blockchain? What is Bitcoin? The Connected World and Blockchain: The Fifth Disruptive Computing Paradigm. How does blockchain work ? How does blockchain accumulate blocks? Tiers of blockchain technology, Features of a blockchain, Types of blockchain. Blockchain Currency: Technology Stack: Blockchain, Protocol, Currency, The Double-Spend and Byzantine Generals' Computing Problems, How a Cryptocurrency Works. Benefits and limitations of blockchain : Technical Challenges, Business Model Challenges, Scandals and Public Perception, Government Regulation, Privacy Challenges for Personal Records, Overall: Decentralization Trends Likely to Persist.	**15 Hours**

Consensus: Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain, CAP theorem and blockchain	
UNIT-II	
Decentralization: Decentralization using blockchain, Methods of decentralization, How to decentralize, Computing power and decentralization, DO, DAO,DAC,DAS,Dapps, Ethereum and Smart Contracts: Definition, Ricardian contracts, Deploying smart contracts on a blockchain, Ethereum Blockchain, Ethereum Network, Components of the Ethereum, ecosystem, Ether cryptocurrency, Introducing Solidity, Global Variables and Functions, Expressions and Control Structures, Writing Smart Contracts, Truffle Basics and Unit Testing, Debugging Contracts Remix IDE: Programs execution.	**15 Hours**
UNIT-III	
Hyperledger: Fabric,The reference architecture, Requirements and design goals of Hyperledger Fabric, Membership services, Blockchain services, Components of the fabric, Chain code implementation, The application model, Consensus in Hyperledger Fabric, The transaction life cycle in Hyperledger FabriC.	**10 Hours**

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

1.	Explain the block chain technology
2.	Illustrate the significance of Consensus and working of cryptocurrency.
3.	Develop block chain-based solutions and write smart contract using Remix IDE and Ethereum frameworks.
4.	Build and deploy block chain application using Truffle Suite.
5.	Create and deploy a block chain network using Hyperledger Fabric SD

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2								1	2
2	2		3						1	2
3	2			2	2				3	2
4	2		3		3				2	3
5	2	2	3		3			2	2	3

TEXTBOOKS:

1. Melanic Swan, "Block Chain: Blueprint for a New Economy", O' Reilly, 2015.
2. Imran Bashir, "Mastering BlockChain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing.
3. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and BlockChain", Packt Publishing

REFERENCE BOOKS:

1. Anshul Kaushik, "BlockChain and Crypto Currencies", Khanna Publishing House, Delhi.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O' Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.
3. Josh Thompsons, "Block Chain: The BlockChain for Beginners-Guide to Block chain Technology and Leveraging BlockChain Programming".
4. Daniel Drescher, "BlockChain Basics", Apress; 1st edition, 2017.

SPEECH PROCESSING

Course Code:	**23CSE232**	**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**

Course Objectives:

1. Understand the fundamentals of speech processing.
2. Study the models of speech processing.
3. Explain the linear predictive coding.
4. Illustrate the application of speech processing.

UNIT-I

Introduction, Fundamentals of Digital Speech Processing, Digital models for the speech signals, Time domain models for	**15Hours**

speech processing, Digital representation of the speech waveform, short term Fourier analysis.	
UNIT-II	
Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.	**15 Hours**
UNIT-III	
Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications Digital speech for man machine communication by voice	**10 Hours**

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

1.	Explain the fundamentals of speech processing.
2.	Understand the various models of speech processing.
3.	Infer the linear predictive coding.
4.	Illustrate the application of speech processing.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	1		2	2					1	
2	1		2	2					1	
3	1		2	2					1	
4	1		2	2					1	

TEXTBOOKS:

1.	Digital Processing of Speech Signals, Lawrence R. Rabiner , Ronald W. Schafer, Pearson

REFERENCE BOOKS:

1.	Speech and Audio Signal Processing, A.R. JAYAN, PHI
2.	Speech and Audio Processing, Apte Shaila D, Wiley India Pvt. Ltd

SOFTWARE ENGINEERING AND MODELING

Course Code:	**23CSE233**	**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**

Course Objectives:

1.	To explain the overview of fundamentals of software process models and principles of engineering concepts related to requirements and architectures
2.	To describe the process of modeling, distributed architecture, software validation and reuse
3.	To establish the foundation on object oriented design principles and patterns
4.	To recognize the importance of software testing and describe the intricacies involved in software maintenance.
5.	To analyze the process of software reuse and explain the importance of distributed software engineering.

UNIT-I	
Software Process Models and Principles Software Process Models: Waterfall, V-model, Spiral iterative and Incremental- Component- based development, Fourth Gen Techniques, Introduction to Agile Software Development, Agile Principles and Practices, Extreme Programming **Modelling Requirements** Software Requirements Engineering, Software Architecture: Architectural Tactics and Patterns- Architecture in the Life Cycle: Architecture and Requirements.	**15 Hours**
UNIT-II	
Modelling Design Designing Architecture. Object Oriented Design, Design principles DFD, UML tools, OOD metrics, Overview of Design Patterns **Software Validation** Introduction to Software Verification Validation, levels of testing, types of testing, Black box design techniques, White box design techniques, statement coverage, decision coverage, condition coverage, Static Review process. Functional non- functional testing. Software Maintenance - Software Maintenance, Software Configuration Management.	**15Hours**
UNIT-III	

Software Reuse Reuse based Software Engineering Approaches, supporting software reuse application frameworks Commercial-Of-The-Shelf(COTS) systems: COTS Solution Systems, COTS Integrated Systems. Component-Based Software Engineering (CBSE) Components, Component Models, CBSE Processes: CBSE for Reuse, CBSE with Reuse, Component-based Development: **Distributed Software Engineering** Distributed Software Engineering, Distributed system characteristics, Design Issues, Middleware Client-Server Computing, Client-Server Interaction, Architectural Patterns for Distributed Systems: Master/Slave, Two-tier, Multi-tier, Distributed component, and Peer-to- Peer Software as a Service (SaaS) Key elements Implementation factors, Configuration of a system offered as a service.	**10 Hours**

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

1.	**Explain** the overview of fundamentals of software process models and principles of engineering concepts related to requirements and architectures
2.	**Describe** the process of modeling, distributed architecture, software validation and reuse
3.	**Establish** the foundation on object oriented design principles and patterns
4.	**Recognize** the importance of software testing and describe the intricacies involved in software maintenance.
5.	**Discuss** the process of software reuse and explain the importance of distributed software engineering.

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	2	3	2		2			2		2
2	2	3	2		2			2		2
3	2	3	2		2			2		2
4	2	3	2		2			2		2
5	2	3	2		2			2		2

TEXTBOOKS:

1.	Roger Pressman, Software Engineering: A Practitioner' s Approach, 7th Edition, McGrawHill,2010.

REFERENCE BOOKS:

1.	Ian Sommerville, Software Engineering, 9th Edition, , Addision-Wesley, 2010.
2.	Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, 3rd Edition, , Addison- Wesley Professional, 2012 (SEI Series in Software Engineering).
3.	Robert E. Filman, Tzilla Elrad, Siobhn Clarke, Mehmet Aksit ,Aspect-Oriented Software Development, Addison-Wesley Professional, 2004.
4.	Martin Fowler, Refactoring: Improving the design of existing code, Addison Wesley, 1999. 5.Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices, Pearson, 2011.
5.	Ian Sommerville, Software Engineering, 9th Edition, , Addision-Wesley, 2010.
E Books / MOOCs/ NPTEL	
1.	https://www.coursera.org/specializations/software-engineering
2.	https://nptel.ac.in/courses/106105182

WEB SERVICES

Course Code:	**23CSE234**	**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**

Course Objectives:

1.	To provide a basic conceptual understanding of web enterprise architectures.
2.	To explore distributed remote communication.
3.	To understand the basic concepts of Service Oriented Architecture.
4.	To explore XML, web services, web service security and its implementation.
5.	To understand micro services and enterprise application patterns.

UNIT-I	
Web Architecture: MVC, middleware - Design considerations, Issues in web application design: Security issues and interoperability issues (WS-I). RPC, Java RMI, message queuing, Data Serialization - MQTT, RabbitMQ, JMS- JSON - AVRO, Thrift, protocol buffer.	**15 Hours**
UNIT-II	
Introducing SOA- SOA triangle, layered architecture of SOA, BPO -	**15 Hours**

Business Process Outsourcing - Web service composition and coordination.	
Web service creation and accessing - WSDL, SOAP, UDDI, XINS, JSON-RPC, JSON-WSP, REST- full web services, mashup, SEMANTIC WEB Services - RDF, RDFS, OWL, SPARQL	
UNIT-III	
Evolution, Modeling services, Integration, Deployment, Testing, Monitoring, Security. Implementation of micro services. Concurrency patterns, Session state patterns. Web service security – protocols.	**10 Hours**

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

1.	To identify issues in web applications architecture 2.To apply distributed communication techniques
2.	To apply Service oriented architecture to provide services to components using communication protocols
3.	To build service oriented architecture for given application 5.To deploy, test and monitor micro services
4.	To identify appropriate enterprise application patterns
5.	To implement different web services architectures
6.	To identify issues in web applications architecture 2.To apply distributed communication techniques
7.	To apply Service oriented architecture to provide services to components using communication protocols

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		2						3	2
2	3		2						3	2
3	3		2		3				3	2
4	3		2						3	2
5	3		2						3	2

TEXTBOOKS:

1.	J.D.Meier,Alex Homer,” Web Application Architecture guide, Patterns and Practices”, Microsoft 2008.

REFERENCE BOOKS:

1.	ThomasErl,” Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.

2.	Andrew S. Tenenbaum, Marteen Van Steen," Distributed Systems, Principles and Paradigms", Second Edition, Pearson, Prentice Hall,2007.
3.	Sam Newman," Building Microservices", O' Reilly,2015.
4.	Martin Fowler, David Rice, Matthew Foemmel, Edward Hieatt, RobertMee,RandyStafford," Patterns of Enterprise Application Architecture", AddisonWesley,2002.7.Sacha Krakowiak," Middleware Architecture with Patterns and Frameworks",2009
5.	Leonard Richardson, Sam Ruby, "Restful Web Services", O' Reilly Media; First Edition edition (May 15, 2007)
6.	Ben Smith," Beginning JSON", Apress,2015
7.	Mark O' Neill ," Web services security" , McGraw Hill,2003
8.	KapilPant, "BusinessProcessOrchestrationforSOAusingBPMNandBPEL", Packt publishing,2008
10.	GustavoAlonso,FabioCasati,HarumiKuno,VijayMachiraju," WebServices-Concepts, Architectures and Applications", Springer Verlag,2004

MOOC Course			
Course Code:		**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**

- Any MOOC course that is having contact hours in the range of 35-45 has to be selected.
- The selected subject is to be approved by the DPGC.
- The MOOC course is to be completed during the time frames of the running semester.
- Student must pass the exam and produce the certificate of clearing the exam.

Audit Courses

DATA ANALYTICS USING R PROGRAMMING

Course Code:	23CSEAP1/2	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

- Introduction to R: Handling Packages in R: Installing a R Package, Input and Output – Entering Data from keyboard – Printing fewer digits or more digits,
- R Data Types, R – Variables, R Operators, R Decision Making, R Loops.
- R-Function, R-Strings, R Vectors, R List, R Matrices, R Arrays.
- Data Frames, Expand Data Frame, Loading and handling Data in R
- R-CSV Files, R -Excel File
- Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median
- Standard Deviation – Correlation - Spotting Problems in Data with Visualization
- R –Pie Charts
- R Histograms

Full stack Web Development

Course Code:	23CSEAP1/2	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

- Requirement analysis and design
- Front end development
- Backend design and development

MOOC Course

Course Code:	23CSEAP1/2	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

Internet of Things (IoT) Concepts and Applications

Course Code:	**23CSE101**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4+0+0+0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Course Objectives:

1.	Explore the IoT concept and Applications
2.	Describe Security and Privacy Framework issues in IoT
3.	Explain the IoT Architectures and requirements, smart office use case
4.	Discuss the market aspects of IoT
5.	Explain the cloud services to IoT

UNIT-I	
Internet of Things Global Standardization - State of Play – Introduction, IoT Vision, IoT Standardization Landscape, **Dynamic Context-Aware Scalable and Trust-based IoT** **Security, Privacy Framework –** Introduction, Main Concepts and Motivation of the Framework, A Policy-based Framework for Security and Privacy in Internet of Things	13

UNIT-II	
Internet of Things Global Standardization - State of Play – Introduction, IoT Vision, IoT Standardization Landscape, **Dynamic Context-Aware Scalable and Trust-based IoT** **Security, Privacy Framework –** Introduction, Main Concepts and Motivation of the Framework, A Policy-based Framework for Security and Privacy in Internet of Things	**13**

UNIT-III	
Scalable Integration Framework for Heterogeneous Smart Objects, Applications and Services – Introduction, IPv6 Potential, IoT6, IPv6 for IoT, Adapting IPv6 to IoT Requirements, IoT6 Architecture, DigCo Integration with the Cloud and EPICS, Enabling Heterogeneous Integration, IoT6 Smart Office Use-case	**10**

UNIT-IV	
Internet of Things Applications - From Research and Innovation to Market Deployment – Introduction, OpenIoT, Icore, Compose, SmartSantander, Fitman, OSMOSE	**8**

UNIT-V	
Insights on Federated Cloud Service Management and the Internet of Things, Introduction, Federated Cloud Services Management	**6**

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

1.	Demonstrate understanding of IoT Concept and Applications
2.	Analyze Security and Privacy Framework issues in IoT
3.	Apply IoT Architecture and requirements in understanding use cases
4.	Analyze the market aspects of IoT
5.	Apply cloud services to IoT

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	PSO↓ 1	PSO↓ 2
1	3		1		1			1		1
2	1		1		1			1		1
3	1		1		1			1		1
4	1		1		1			1		1
5	3		1		1			1		1

1: Low, 2: Medium, 3: High

TEXTBOOKS:

1. **Internet of Things From Research Innovation to Market Development , Dr, Ovidiu Vermesan**

   SINTEF Norway, Dr. Peter Friess, EU Belgium, River Publishers, Aalborg

2. **Reference Books:**

   The Definitive Guide to the Internet of Things for Business, 2nd Edition, By Syed Zaeem Hosain, CTO, Aeris

E-Books / Online Resources:

http://www.internet-of-things-research.eu/pdf/IoT-From%20Research%20and%20Innovation%20to%20Market%20Deployment_IERC_Cluster_eBook_978-87-93102-95-8_P.pdf, http://www.internet-of-things-research.eu/pdf/Digitising_the_Industry_IoT_IERC_2016_Cluster_eBook_978-87-93379-82-4_P_Web.pdf

MOOC:

Stanford:https://www.class-central.com/mooc/6748/coursera-introduction-to-architecting-smart-iot-devices

https://www.class-central.com/mooc/4338/coursera-introduction-to-the-internet-of-things-and-embedded-systems