GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution Affiliated to VTU, Belagavi)
Accredited by NAAC with 'A' Grade,
NBA Accredited - CSE, ISE, ECE, EEE, ME, CV
Ideal Homes Township, Raja Rajeshwari Nagar, Bengaluru-560098

Scheme and Syllabus of I to IV Semester

(Autonomous System of 2023 Scheme)

Master of Technology (M.Tech)

in

COMPUTER SCIENCE AND ENGINEERING

H.N. Rajashekar Anand
Dean Academic
Global Academy of Technology
Rajarajeshwarinagar, Bengaluru-98

Sleshaary
Head of Department
Computer Science Engineering
Global Academy of Technology
Bangalore-98

Department of Computer Science and Engineering

Vision

To achieve academic excellence and strengthen the skills to meet emergingchallenges of computer science and engineering.

Mission

- To impart strong theoretical foundation in the field of ComputerScience and Engineering accompanied with extensive practical skills.
- To inculcate research and innovation spirit through interaction withindustry and carry out projects that address societal needs.
- Instill professional ethics and values with a concern for environment.

Program Outcomes (POs)

Computer Science and Engineering Post Graduates inculcate

PO1:

An ability to independently carry out research/investigation and development work to solve practical problems.

PO2:

An ability to write and present a substantial technical report/document.

PO3:

An ability to demonstrate a degree of mastery over Computer Science and Engineering.

PO4:

An ability to acquire a sense of ethical and moral integrity in Applications of Computer Science and Engineering with concern to Environment and sustainability.

PO5:

An ability to inculcate a personality trait to be open to learn, unlearn and relearn concepts and skills for the life time.

I SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P	CIE	SEE	Total	
1	23MCS11	Linear Algebra & Advanced Probability	BSC	MAT	03	00	00	50	50	100	3
2	23MCS12	Cloud Computing and Big Data Analytics	IPCC	CSE	03	00	02	50	50	100	4
3	23MCS13	Advances in Computer Networks	PCC		03	02	00	50	50	100	4
4	23MCS14	Computational Algorithms	PCC		02	02	00	50	50	100	3
5	23MCS15	Data Science	PCC		02	02	00	50	50	100	3
6	23RMI16	Research Methodology and IPR	MCC		03	00	00	50	50	100	3
7	23MCSL17	Full Stack Development Laboratory	PCCL		01	00	02	50	50	100	2
8	23AUD18	BOS recommended ONLINE courses	AUD		Classes and evaluation procedures are as per the policy of the online course providers						PP
Total								**350**	**350**	**700**	**22**

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Note:

BSC	Basic Science Courses,
PCC	Professional core.
IPCC	Integrated Professional Core Courses,
MCC	Mandatory Credit Course,
AUD/AEC	Audit Course / Ability Enhancement Course A pass in AUD/AEC is mandatory for the award of the degree),
PCCL	Professional Core Course lab

Integrated Professional Core Course (IPCC): Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses): Audit Courses: These are prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

Ability Enhancement Courses:

- These courses are prescribed to help students to enhance their skills in in fields connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
- The Audit Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

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II SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P	CIE	SEE	Total	
1	23MCS21	Block Chain Technology	PCC	CSE	02	02	00	50	50	100	3
2	23MCS22	Deep Learning	IPCC		03	00	02	50	50	100	4
3	23MCS23X	Professional Elective 1	PEC		03	00	00	50	50	100	3
4	23MCS24X	Professional Elective 2	PEC		03	00	00	50	50	100	3
5	23MCS25	Mini Project with Seminar	MPS		00	00	06	100	--	100	3
6	23MCSL26	Data Analytics using Tableau Laboratory	PCCL		01	00	02	50	50	100	2
7	23AUD27	BOS recommended ONLINE courses	AUD		Classes and evaluation procedures are as per the policy of the online course providers						PP
Total								**350**	**250**	**600**	**18**

Professional Elective 1		Professional Elective 2	
23MCS231	Pattern Recognition	**23MCS241**	Human Computer Interaction
23MCS232	Wireless Networks and Mobile Computing	**23MCS242**	Edge and Fog Computing
23MCS233	Agile Technology	**23MCS243**	Augmented and Virtual Reality

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III SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P	CIE	SEE	Total	
1	23MCS31	Large Language Models	PCC	CSE	04	00	00	50	50	100	4
2	23MCS32X	Professional Elective 3	PEC		03	00	00	50	50	100	3
3	23MCS33X	Professional Elective 4	PEC		03	00	00	50	50	100	3
4	23MCS34	Project Work Phase I	PROJ		00	00	06	100	--	100	3
5	23MCS35	Societal Project	SP		00	00	06	100	--	100	3
6	23MCSI36	Internship	INT		(06 weeks Internship Completed during the intervening vacation of II and III semesters.)			50	50	100	6
Total								**400**	**200**	**600**	**22**

Professional Elective 3		Professional Elective 4	
23MCS321	Generative AI	**23MCS331**	Cyber Security and Digital Forensics
23MCS322	Robotic Process and Automation	**23MCS332**	Multicore Architecture and Programming
23MCS323	Computer Vision	**23MCS333**	Quantum Computing

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IV SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P	CIE	SEE	Total	
1	23MCS41	Project Work Phase -2	Project	CSE	-	-	09	100	100	200	18
Total								**100**	**100**	**200**	**18**

ASSESSMENT DETAILS

1. IPCC Courses Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

CIE for the theory component of IPCC

1. Two Tests each of 20 Marks
2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks.

CIE for the practical component of IPCC

1. On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 10 marks are for conducting the experiment and preparation of the laboratory record, the other 10 marks shall be for the test conducted at the end of the semester.
2. The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments 'write-ups are added and scaled down to 10 marks. The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
3. Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

1. Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).
2. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
3. The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.

2. PCC/MCC/BSC/PEC Courses Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

CIE Component

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks as prescribed the course instructor.
3. The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks of CIE.

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SEE Component

1. Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).
2. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

3. PCCL Courses Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

CIE Component

1. The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

SEE Component

1. SEE marks for the practical course is 50 Marks.
2. All laboratory experiments are to be included for practical examination.
3. General rubrics suggested for SEE are : writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks.
4. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours.

SEMESTER I

COURSE: LINEAR ALGEBRA & ADVANCED PROBABILITY

Course Code:	23MCS11	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Solving systems of linear equations
CLO2	Understanding vector spaces, linear transformations.
CLO3	Understanding Eigenvalues, Eigenvectors, diagonalization and Singular value decomposition
CLO4	Understanding random variables and probability distributions.

CONTENTS	# of Hours
MODULE 1 System of linear equations, row reduction and echelon form, vector equations, The matrix equation AX = b. Linear independence and introduction to linear transformations.	8
MODULE 2 Matrix of linear transformation, matrix operations, invertible matrix, inverse of a matrix by Gauss Jordan method. Vector space, subspaces, linearly independent sets, Bases.	8
MODULE 3 Coordinate systems, The dimensions of a vector space, Rank, Change of basis. Eigen vectors and Eigen values, diagonalization, Eigen vectors and linear transformations.	8
MODULE 4 Random Variable, Probability Distributions, Marginal Probability, Conditional Probability, Bayes' Rule, Expectation, Variance and Covariance	8
MODULE 5 Bernoulli Distribution, Multinoulli Distribution, Gaussian Distribution, Exponential and Laplace Distributions, The Dirac and Empirical Distributions	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO11.1	Solve systems of linear equations.
CO11.2	Manipulate matrices and do matrix algebra
CO11.3	Work within vector spaces
CO11.4	Use computational techniques for the study of Eigenvalues, Eigenvectors, and diagonalization
CO11.5	Solve problems associated with random variables using probability distributions

Reference Books:

1. David C Lay, Linear Algebra and its applications, Pearson, 4th Edition, 2012.
2. T Veerarajan, Probability, Statistics and Random Processes for Engineers, Tata McGraw Hill, 3rd Edition, 2008.
3. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning, 4th Edition, 2006.
4. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall, 2nd Edition, 2004.
5. Richard H Williams, Probability, Statistics and Random Processes for Engineers, Cengage Learning, 1st Edition, 2003.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO11.1	2	1	-	1	1
CO11.2	2	1	-	1	1
CO11.3	2	1	-	1	1
CO11.4	2	1	-	1	1
CO11.5	2	1	-	1	1
Average	**2**	**1**	-	1	1

Low-1: Medium-2: High-3

COURSE: CLOUD COMPUTING AND BIG DATA ANALYTICS

Course Code:	23MCS12	CIE Marks:	50
Hours/Week (L: T: P):	3:0:2	SEE Marks:	50
Total Hours:	50	Examination Hours:	3
No. of Credits:	4		

Course Learning Objectives:

The course will enable students to:

CLO1	Demonstrate cloud Infrastructure computing and Cloud Resource Virtualization
CLO2	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data
CLO3	Explore Hadoop Distributed File system and MapReduce programming model to process Big data

CONTENTS	# of Hours
MODULE 1 **Cloud Computing and Big Data** Introduction: Defining cloud computing, cloud types, examining the Characteristics of cloud Computing Historical Developments, Virtualization, introduction, characteristics of virtuarized Environments, Virtualization, Taxonomy of Techniques, Execution Virtualization, Other Types of Virtualization, virtualization and cloud computing, pros and Cons of virtualization, Technology Examples: VMware: Full virtualization	8
MODULE 2 **Cloud Computing Architecture**: Introduction, cloud reference model, architecture infrastructure/ Hardware as a service, platform as a service, software as a service, Types of Clouds, public Clouds, private Clouds, Hybrid clouds, community clouds, Economics of the cloud, open challenges, Cloud Definition, cloud interoperability and standards scalability and Fault Tolerance, security, Trust, and privacy organizational Aspects, Aneka application framework overview.	8
MODULE 3 **Case Study on Open Source & Commercial Clouds**: Amazon AWS, Google Cloud, Microsoft Azure Using Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Understanding Amazon Database services, Google App Engine, Architecture and core concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance, CRM and ERP.	8
MODULE 4 **Introduction to Big Data Analytics:** Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing,	8

Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, Map Reduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools	
MODULE 5 **NoSQL Big Data Management, MongoDB and Cassandra:** Introduction, NoSQL Data Store, NoSQL to Manage Big Data, MongoDB, Databases, Cassandra Databases. **Map Reduce, Hive and Pig:** Introduction, Map Reduce Map Tasks, Reduce Tasks and Map Reduce Execution, Composing Map Reduce for Calculations and Algorithms, Hive, HiveQL	8

Laboratory Component

List of exercises for which student should develop programs and execute in theLaboratory

1. Implement a map reduce for word count from a given input text file.
2. Execute a Map reduce python program for printing maximum salary for a given input file.
3. Execute a python program to implement map reduce concepts for printing year wise sales from a given csv file.
4. Execute a python program to implement map reduce for inverted index of a given data set.
5. Execute a python program to implement word count using spark cell
6. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
7. Implement Functions: Count – Sort – Limit – Skip – Aggregate Using MongoDB.
8. Installation of open source hypervisors such as VMWare Player.

Course Outcomes: Upon successful completion of this course, student will be able to

CO12.1	Describe the Delivery models, Services and Applications of Cloud Computing
CO12.2	Discuss Cloud Resource Virtualization, Resource Management & Scheduling and Cloud Security
CO12.3	Explain Big Data Concepts and NoSQL Data Management with respect to Cloud
CO12.4	Describe the role of Hadoop in various MapReduce Applications
CO12.5	Explain the Big Data using Hadoop Ecosystem and Spark Programming model

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education.
2. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 .

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO12.1	1	1	2	2	2
CO12.2	1	1	2	2	2
CO12.3	1	1	2	2	2
CO12.4	1	1	2	2	2
CO12.5	1	1	2	2	2
Average	**1**	**1**	**2**	**2**	**2**

Low-1: Medium-2: High-3

COURSE: ADVANCES IN COMPUTER NETWORKS

Course Code:	23MCS13	CIE Marks:	50
Hours/Week (L: T: P):	3:2:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	4		

Course Learning Objectives:

The course will enable students to:

CLO1	Discuss with the basics of Computer Networks and Internet addressing
CLO2	Demonstrate various Routing-update algorithms
CLO3	Analyze network traffic, congestion, controlling and resource allocation
CLO4	Discuss Cellular Networks and LTE Technology
CLO5	Explain fundamentals of Network management

CONTENTS	# of Hours
MODULE 1 **Foundation:** Building a Network, Applications, Requirements, Architecture, Software Performance, Packets: Packet Delay, Variability, Packet Size, Error Detection. IP Version 4- The IPv4 Header, Special Addresses, IPv4 Subnets, Dynamic Host Configuration Protocol (DHCP), IP version 6-IPv6 Header, IPv6 addresses, IPv6 Host Address Assignment, ICMPv6.	8
MODULE 2 **Routing-Update Algorithms:** Distance-Vector Routing-Update Algorithm, Distance-Vector Slow-Convergence Problem, Loop-Free Distance Vector Algorithms: DSDV, AODV, Link-State Routing-Update Algorithm: Shortest- Path-First Algorithm, Classless Internet Domain Routing: CIDR, Hierarchical routing, Provider- Based Routing	8
MODULE 3 **Congestion Control and Resource Allocation:** Issues in resource allocation – network model, taxonomy, evaluation criteria; Queuing discipline – FIFO, Fair Queuing; TCP congestion control – additive increase/multiplicative decrease, slow start, fast retransmit and fast Recovery, Congestion-avoidance mechanisms– DECbit, Random Early Detection (RED), Source-based congestion control.	8
MODULE 4 **Cellular Networks and LTE Technology**: The Cellular Concept – System Design Fundamentals: Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Long-Term Evolution (LTE) Introduction: Architectural Review of UMTS and GSM, The Need for LTE, From UMTS to LTE, From LTE to LTE-Advanced, System Architecture Evolution: High-Level Architecture of LTE, User Equipment.	8
MODULE 5 **Network Management:** Goals, Organization, and Functions, Architecture and Organization, Perspectives	8

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Basic Foundations: Standards, Models and Language: Standards, Models (Organizational, Information, Communicational, Functional), ASN.1, Encoding Structure, Macros.	

Course Outcomes: Upon successful completion of this course, student will be able to

CO13.1	Develop the fundamental concepts in networks and addressing mechanism using IPv4 and IPv6
CO13.2	Apply the different routing techniques for a network to find shortest path.
CO13.3	Model various congestion control mechanism and bottlenecks in TCP.
CO13.4	Identify Cellular networks and LTE technology.
CO13.5	Discuss fundamentals of Network management.

Reference Books:

1. Peter L Dordal, "An Introduction to Computer Networks", Open Access Book, 2016.
2. Larry L. Peterson, Bruce S Davie," Computer Networks: A Systems Approach", Elsevier, 2007.
3. Network Management Principles and Practice, Mani Subramanian, Pearson, 2010.
4. Theodore S Rappaport, Wireless Communications Principles and Practice, Pearson, 2nd Edition, 2010.
5. Christopher Cox, An Introduction to LTE, Wiley, 2nd Edition, 2014.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO13.1	2	2	2	1	1
CO13.2	2	2	2	1	1
CO13.3	2	2	2	1	1
CO13.4	2	2	2	1	1
CO13.5	2	2	2	1	1
Average	**2**	**2**	**2**	**1**	**1**

Low-1: Medium-2: High-3

COURSE: COMPUTATIONAL ALGORITHMS

Course Code:	23MCS14	CIE Marks:	50
Hours/Week (L: T: P):	2:2:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Analyze the asymptotic performance of algorithms.
CLO2	Demonstrate a familiarity with major algorithms
CLO3	Apply important algorithmic design paradigms and methods of analysis.

CONTENTS	# of Hours
MODULE 1 **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	8
MODULE 2 **Number -Theoretic Algorithms:** Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization.	8
MODULE 3 **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. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.	8
MODULE 4 **String-Matching Algorithms:** Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms	8
MODULE 5 **Probabilistic and Randomized Algorithms:** Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO14.1	Design and apply iterative and recursive algorithms and Analyze the running time complexities of algorithms
CO14.2	Apply the concept of Number -Theoretic Algorithms
CO14.3	Identify the application scenario for graph algorithms
CO14.4	Illustrate string matching algorithm.
CO14.5	Apply the concept of Probabilistic and Randomized Algorithms

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, PHI, India, 2nd Edition.
2. Horowitz, Sahani and Rajsekaran, Fundamentals of Computer Algorithms.
3. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithm, Cambridge University Press.
4. Aho, Hopcroft, Ullman: The Design and Analysis of Algorithms, Pearson Education.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO14.1	1	1	2	1	2
CO14.2	1	1	2	1	2
CO14.3	1	1	2	1	2
CO14.4	1	1	2	1	2
CO14.5	1	1	2	1	2
Average	**1**	**1**	**2**	**1**	**2**

Low-1: Medium-2: High-3

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COURSE: DATA SCIENCE

Course Code:	23MCS15	**CIE Marks:**	50
Hours/Week (L: T: P):	2:2:0	**SEE Marks:**	50
Total Hours:	40	**Examination Hours:**	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Provide with the knowledge and expertise to become a proficient data scientist
CLO2	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
CLO3	Understand the basic and advanced statistics for data science
CLO4	Understand the optimization techniques for design

CONTENTS	# of Hours
MODULE 1 **Introduction to Data Science:** Introduction, Benefits and uses, Facets of data, Data science process, Big data ecosystem and data science, The Data science process, Overview, research goals retrieving data transformation, Exploratory Data Analysis Model building.	8
MODULE 2 **Machine Learning:** Introduction Machine learning algorithms, Modeling process, Types–Supervised, Unsupervised, Semi-supervised, Handling larger data on a single computer.	8
MODULE 3 **Statistics:** Introduction, sampling of data - probability Sampling, random Sampling, Unequal probability sampling, measures of centre, measures of variation, coefficient of variation, measure of relative standing, z-score, correlation in data, Empirical rule, examples.	8
MODULE 4 **Advanced Statistics:** Point estimates, sampling distribution, confidence intervals hypothesis tests, conducting a hypothesis test, One Sample t-test, type I and type II errors, hypothesis tests for categorical variables, chi-square test, chi square Independence test and examples.	8
MODULE 5 **Optimization:** Optimization: Components of Optimization, Objective Function, Constraints, Bounded and unbounded problem, Monotonic Functions, Convex functions, Unimodal functions, Multimodal function, Classification of Optimization problems, Classification of Optimization techniques, multi-objective Optimization, Saddle point for single objective function, Linear programming, Non-linear programming	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO15.1	Understand the preliminaries of data science.
CO15.2	Interpret the concept of machine learning and apply it to real time applications.
CO15.3	Explain the statistical methods and its applications for data science.
CO15.4	Explain the advanced statistical methods and its applications for data science.
CO15.5	Apply and analyze the optimization techniques of a model.

Reference Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications 2016.
2. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithm and Example", New Delhi PHI Learning Private Limited 2012.
3. Ozdemir, Sinan, "Principles of data science", Packt Publishing Ltd, 2016.
4. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.
5. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison Wesley Data & Analytics Series, 2013.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO15.1	2	2	1	2	2
CO15.2	2	2	1	2	2
CO15.3	2	2	1	2	2
CO15.4	2	2	1	2	2
CO15.5	2	2	1	2	2
Average	**2**	**2**	1	**2**	**2**

Low-1: Medium-2: High-3

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COURSE: RESEARCH METHODOLOGY AND IPR

Course Code:	23RMI16	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	03
No. of Credits:	03		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the preliminaries of research and defining of a research problem
CLO2	Understand the design of research and its various components
CLO3	Interpret descriptive statistics in testing of hypothesis
CLO4	Interpret research and writing of research reports
CLO5	Understand intellectual property and patents both in Indian and global context

CONTENTS	# of Hours
MODULE 1 **Introduction to Research:** Introduction, meaning of research, Objectives of research, types of research, approaches of research, significance of research, research methods Vs research methodology, research and scientific method, research process, criteria of good research. Problems encountered by researchers in India. Research problem, selecting the problem, necessity of defining the problem, techniques involved in defining a problem.	8
MODULE 2 **Research Design:** Meaning of research design, need for research design, features of a good research design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental design, Sample design, sampling and non-sampling errors, sample survey Vs Census Survey, types of sampling design, examples and numeric problems.	8
MODULE 3 **Statistics and Hypothesis Testing**: Measures of Central tendency, measures of dispersion, measure of skewness, measure of kurtosis, measures of relationship: covariance, Karl Pearson's coefficient of Correlation. **Hypothesis:** Basic concepts concerning testing of hypothesis, testing the hypothesis, test statistic and critical region, Critical value and decision rule, procedure for hypothesis testing, Student's t-test, ANOVA test	8
MODULE 4 **Interpretation and Report Writing**: Meaning of interpretation, techniques of interpretation, precautions in interpretation, Significance of report writing, different steps in report writing, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research report	8

MODULE 5 **Intellectual Property Rights:** What is Intellectual Property (IP), types of IP - patents, copyright, trademarks, industrial designs, geographical indications, trade secrets, kind of protection offered to the parent owner, geographical jurisdiction of patent, duration of patent, frontier technologies, role of frontier technologies, role of WIPO, Indian patents, steps in filing of a patent, processing of patent applications in India, types of patents, current patent application form in India, Indian Patent Advanced Search System (in PASS), patent offices in India and their territorial jurisdiction, Brief history of Indian patent system	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO16.1	Explain basic concepts of research and process of defining a research problem.
CO16.2	Understand research design and to various aspects.
CO16.3	Apply descriptive statistics in hypothesis testing.
CO16.4	Organize a research report based on the findings of a given research.
CO16.5	Summarize intellectual property concepts both in the context of India and worldwide.

Reference Books:

1. Kothari, Chakravanti Rajagopalachari, Research methodology, New Age, 2004.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO16.1	3	3	1	1	1
CO16.2	3	3	1	1	1
CO16.3	3	3	-	-	-
CO16.4	3	3	-	-	-
CO16.5	3	3	-	-	-
Average	**3**	**3**	**1**	**1**	**1**

Low-1: Medium-2: High-3

COURSE: FULL STACK DEVELOPMENT LABORATORY

Course Code:	23MCSL17	CIE Marks:	50
Hours/Week (L: T: P):	1:0:2	SEE Marks:	50
No. of Credits:	2	Examination Hours:	3

List of exercises for which student should develop programs and execute in theLaboratory

CONTENTS
MODULE 1 **Introduction to React JS:** Why React? What is React? Features of React, setting up a React Project, Hello React, React Component, React JSX, styling react components.
MODULE 2 **State and Props:** Why Props and State? How to work with state?, useState, how to use props, passing methods as Props, Accessing Child Nodes.
MODULE 3 **React Forms and Router** Why Forms? React Form Elements, React refs, Routing in React styling forms, Form Validation, Routing in React: Why Router? Router Configuration.
MODULE 4 **Node.js and Express.js:** What is node.js? Getting started with Node.js, create web server in Node.js, Node package Manager (NPM), Express Development Environment, Routing, Middleware.
MODULE 5 **Connecting to MongoDB:** Introduction, Schema, Validation and defaults, Models. CRUD Operations - Create, Read, Update and Delete.

Reference Books:

1. FullStack React: The Complete Book on ReactJS and Friends by Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Gutman, and Tyler McGinnis
2. Get Programming with Node.js by Jonathan Wexler
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB by Azat Mardan
4. Full-Stack JavaScript Development by Eric Bush.
5. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski, Maciej Czarnecki

Lab Programs

Program 1

a) Create a component called Profile in a file named Profile.js. This component should return name of the person as heading, image of a person and description of the person. Also, export the component as the default export.
b) Create another component called Gallery in a file named Gallery.js. This Gallery component should import the Profile component and export itself as a named export.
c) Inside App component render Gallery component

Program 2

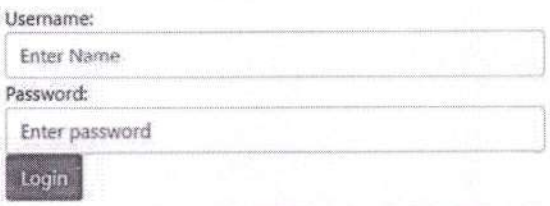
a) Create a JavaScript object named scientist1 that contains details about the first scientist (e.g., id, name, image, profession, and description). Create a second JavaScript object named scientist2 with details about a second scientist
b) Create a component called Profile in a file named Profile.js. This Profile component should take the scientist's details as props and render thèm (e.g., name, image, profession, and description).
c) Create a component called Card in a file named Card.js. The Card component should access the Profile component using the children prop.
d) Inside the App component, render two Card components. Each Card component should wrap a Profile component, and you should pass the scientist1 object as props to the first Profile component and the scientist2 object as props to the second Profile component

Program 3

a) Create a JavaScript object named productsData that contains an array of product objects. Each product object should include details such as id, name, price, description, and available (a boolean indicating whether the product is in stock or not)
b) Create a component named ProductList in a file named ProductList.js. The ProductList component should map through the productsData array and render a Product component for each product. Pass the product object as props to each Product component.
c) Create a component named Product in a file named Product.js. The Product component should receive the product object as props and conditionally render different content based on the available property. If the product is available (available : true), display its name, price, and description. If the product is not available (available : false), display a message saying "Out of stock".
d) Inside the App component, render the ProductList component

Program 4

Develop a Login component utilizing form elements as outlined below:



Additionally, implement form validation. If the user attempts to submit without entering a username or password, the system should display an error indicating empty fields. Otherwise, upon successful completion, the login should be acknowledged as successful.

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Program 5

Create a registration form like the one shown below and make sure each part of the form has validation

Program 6

Create a student management system using React. Implement routing to manage different views such as a student list and individual student profiles. Develop functionalities within the admin panel for adding, editing, and removing students, ensure seamless navigation between these views while displaying relevant information on each page

Program 7

Develop an Express.js application that efficiently handles routes for various shopping sections such as '/products', '/cart', and '/checkout'. Implement custom middleware in Express.js to log essential information from incoming requests, including request method, URL, timestamp, and client's IP address

Program 8

Create Node.js application with the appropriate MongoDB driver, that handles the following CRUD operations for the employee database:

a) Implement an endpoint to add new employee to the employee collection. Each employee should have fields such as employeeID, name and designation.
b) Develop an endpoint to retrieve employees from the collection based on various search criteria employeeID.
c) Provide an endpoint that allows users to update specific details of an employee (e.g., change name, update designation).
d) Create an endpoint to remove employee from the collection based on emplyeeID.

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Course Outcomes: Upon successful completion of this course, student will be able to

CO17.1	Design, and style React applications, incorporating components, JSX, and basic project structure for effective user interface development
CO17.2	Demonstrate proficiency in managing component state, passing and utilizing props, and implementing parent-child component communication within React applications.
CO17.3	Design and implement dynamic forms, handle form data and events, apply form validation techniques, and configure routing for multi-page React applications.
CO17.4	Demonstrate proficiency in applying Node.js to set up a web server, utilizing NPM for package management, implementing routing and middleware in Express.js
CO17.5	Design MongoDB schemas, performing CRUD operations, and effectively connecting and interacting with MongoDB databases in web applications.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO17.1	2	-	2	1	1
CO17.2	2	-	2	1	1
CO17.3	2	-	2	1	1
CO17.4	2	-	2	1	1
CO17.5	2	-	2	1	1
Average	**2**	-	**2**	**1**	**1**

Low-1: Medium-2: High-3

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SEMESTER – II

COURSE: BLOCK CHAIN TECHNOLOGY

Subject Code	23MCS21	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
Total Hours	40	Examination Hours	3
No. of Credits: 3			

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the basic terminologies of cryptography and Hash functions.
CLO2	Understand how Block chain systems such as Bitcoin and Ethereum work.
CLO3	Explain the role of Consensus mechanisms & Smart contracts in Block Chain.
CLO4	Understand various applications of Block chain.

CONTENTS	# of Hours
MODULE-1 **Basics of Block Chain**: Defining Block Chain, Generic elements of a Block chain, How Block chain works, Features of Block chain, Types of Block chain, CAP theorem and Block chain. Distributed Ledger Technologies, Forks in Block Chain. **Decentralization:** Decentralization using Block Chain, Requirements of a Decentralized Applications (DApps), DApp examples, Platforms for Decentralization.	8
MODULE-2 **Cryptography and Technical Foundations:** Cryptographic services & primitives, Symmetric cryptography: Stream and Block Ciphers, Elliptic Curve Cryptography. **Hash Functions:** Basics, Message Authentication Code & its properties, Design of SHA-256, SHA-3(Keccak) algorithms, Merkle & Petricia trees, Distributed Hash Tables, Digital Signatures: RSA Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm.	8
MODULE-3 **Bitcoin:** Bitcoin, Digital keys and addresses, Private and Public keys in Bitcoin, Addresses in Bitcoin, Transactions, Block Chain: Structure of Block, Bitcoin Network, Bitcoin Wallets, Bitcoin Installation & Programming, Bitcoin limitations. **Consensus Algorithms:** Mining: Tasks of Miners, Mining Algorithm, Nakamoto Consensus, Proof of Work, Proof of Stake, Proof of Burn	8
MODULE-4 **Ethreum:** Introduction, EVM, Working of Ethereum, Components of Ethreum Ecosystem, Ether cryptocurrency, EVM, Smart Contracts: Basics, Recardian Contracts **Development tools and Frameworks:** Remix, MetaMask, Ganache, Solidity language.	8
MODULE-5 **Alternative Blockchains:** Kadena, Ripple, Stellar, Quorum **Blockchain-Outside of Currencies:** Internet of Things, Government, Health, Financial Crime Prevention.	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO21.1	Explain the terminologies and types of Block Chain.
CO21.2	Describe various cryptographic algorithms and Hash concepts in Block Chain.
CO21.3	Explain the Bitcoin features and the importance of Consensus in Block chain.
CO21.4	Explain Ethereum Block Chain using Smart Contracts, various tools and frameworks learnt.
CO21.5	Discuss about alternative block chains available and various applications of Block Chain outside the currencies..

Reference Books:

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, 2018.
2. Blockchain Technology Concepts and Applications, Kumar Saurabh,Ashuthosh Saxena,Wiley emerging technology series,2020.
3. Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016 Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
4. DR. Gavin Wood, ``ETHEREUM: A Secure Decentralized Transaction Ledger, "Yellow paper.2014.
5. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", VPT, 2017

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO21.1	-	-	1	-	1
CO21.2	2	2	3	-	1
CO21.3	-	-	3	2	3
CO21.4	2	2	3	2	3
CO21.5	-	-	2	2	1
Average	**2**	**2**	**3**	**2**	**1**

Low-1: Medium-2: High-3

Shiwarny

COURSE: DEEP LEARNING

Course Code:	23MCS22	CIE Marks:	50
Hours/Week (L: T: P):	3:0:2	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	4		

Course Learning Objectives:

The course will enable students to:

CLO1	Introduce the idea of Artificial Neural Networks and their applications.
CLO2	Study and implement different architectures of Artificial Neural Networks.
CLO3	Study and implement various optimization techniques on Artificial Neural Networks
CLO4	Enable design and deployment of deep learning models for machine learning probiems.

CONTENTS	# of Hours
MODULE 1 **Introduction:** Artificial Intelligence and Deep Learning-a historical perspective, Artificial neural networks, Shallow neural networks, Deep neural networks, gradient descent, forward and backpropagation, computational graphs, linear and non-linear activation functions.	8
MODULE 2 **Optimization Techniques:** Regularization, Dropout, Batch Normalization, Vanishing/Exploding gradients, Mini-batch gradient, Gradient descent with momentum, RMSprop, Adam optimization, Learning rate decay, Local optima, Global optima. Hyperparameter tuning.	8
MODULE 3 **Convolutional Neural Networks:** Basic operations: padding, stride, pooling; Classic convolutional models: LeNet-5, AlexNet, VGG, Modern Deep Convolutional models: ResNet, GoogleNet; Inception Network, 1-D convolutions, Object detection and Face Recognition with CNN.	8
MODULE 4 **Recurrent Neural Networks:** Sequence modelling, Types of Recurrent Neural Networks, Backpropagation through time, Language modelling and sequence generation, Word Embeddings, vanishing gradients with RNNs, Long-Short Term Memory (LSTM), Gated Recurrent MODULEs (GRU), Bidirectional LSTMs, Sequence-to-Sequence model, Attention Mechanism, Transformer Network.	8
MODULE 5 **Advanced Topics:** Deep Reinforcement Learning, Generative Adversarial Networks, Generative vs. Discriminative models, Deep Convolution GANS, Autoencoders, NLP Applications.	8

Laboratory Component

List of exercises for which student should develop programs and execute in theLaboratory

1. Basic image processing operations: Histogram equalization, Thresholding, edge detection, data augmentation, morphological operations
2. Implement SVM/Softmax classifier for CIFAR-10 dataset: (i) using KNN, (ii) using 3 layer neural network
3. Study the effect of batch normalization and dropout in neural network classifier
4. Familiarization of image labelling tools for object detection, segmentation
5. Image segmentation using Mask RCNN, UNet, SegNet
6. Object detection with single-stage and two-stage detectors (Yolo, SSD, FRCNN, etc.)
7. Image Captioning with Vanilla RNNs
8. Image Captioning with LSTMs

Course Outcomes: Upon successful completion of this course, student will be able to

CO22.1	Understand the functioning of Mathematics and Science in ANN
CO22.2	Apply the optimization techniques in Parameter tuning of Deep Learning Models
CO22.3	Apply CNN with its basic building blocks.
CO22.4	Design and deploy deep learning solutions for real-world applications with popular deep learning tools.

Reference Books:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning- A textbook", 2018, Springer.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series", MIT Press.
3. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms", O'Reilly Media.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO22.1	-	1	1	1	2
CO22.2	2	2	1	1	2
CO22.3	2	2	1	1	2
CO22.4	2	2	1	1	2
Average	**2**	**2**	**1**	**1**	**2**

Low-1: Medium-2: High-3

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COURSE: PATTERN RECOGNITION

Course Code:	23MCS231	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the Different paradigms for Pattern Recognition and fundamentals of probability
CLO2	Explain the Feature extraction, Feature selection
CLO3	Explain the Nearest Neighbor based classifiers & Bayes classifier
CLO4	Discuss Naive Bayes classifier, Bayesian belief network, Decision Trees
CLO5	Discuss Clustering techniques

CONTENTS	# of Hours
MODULE 1 **Introduction:** Definition of Pattern Recognition, Applications, Datasets for Pattern Recognition, Different paradigms for Pattern Recognition, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.	8
MODULE 2 **Representation:** Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.	8
MODULE 3 **Nearest Neighbor based classifiers & Bayes classifier:** Nearest neighbor algorithm, variants of algorithms, use of for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network.	8
MODULE 4 **Naive Bayes classifier**: Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, over fitting & Pruning, Examples, Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM.	8
MODULE 5 **Clustering:** Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means,Isodata),clustering large datasets, examples, An application: Handwritten Digit recognition.	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO231.1	Identify the different paradigms and statistical foundations of Pattern Recognition
CO231.2	Analyze the data structures and data abstraction techniques for Pattern Recognition
CO231.3	Examine the different classifiers and implement the algorithms
CO231.4	Evaluate the use of Bayesian belief networks, decision trees and hidden Markov models for classification tasks
CO231.5	Illustrate the hierarchical and partitional clustering techniques and its application in Pattern Recognition.

Reference Books:

1. V Susheela Devi, M Narasimha Murthy, Pattern Recognition (An Introduction), Universities Press, 2011.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, PHI, 1996.
3. Duda R. O., P.E. Hart, D.G. Stork, Pattern Classification, John Wiley and sons, 2000.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO231.1	1	-	-	-	-
CO231.2	2	1	-	1	-
CO231.3	2	1	1	1	-
CO231.4	2	1	1	1	-
CO231.5	2	1	1	-	-
Average	**2**	**1**	**1**	1	-

Low-1: Medium-2: High-3

COURSE: WIRELESS NETWORKS AND MOBILE COMPUTING

Course Code:	23MCS232	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the basics of wireless networks and connectivity issues.
CLO2	Understand the Wireless Local Area Network technology with its protocols and applications.
CLO3	Understand the Wireless Personal Area Network technology with its protocols and applications.
CLO4	Understand the Wireless Wide Area Network technology with its protocols and applications.
CLO5	Understand Wireless Ad Hoc Networks and its technologies.

CONTENTS	# of Hours
MODULE 1 **Fundamentals of Wireless Communication:** Advantages, Limitations and Applications, Wireless Media, Infrared Modulation Techniques, Spread spectrum: DSSS and FHSS, Diversity techniques, MIMO, Channel specifications- Duplexing, Multiple access technique: FDMA, TDMA, CDMA, CSMA, OFDMA fundamentals,Frequency Spectrum, Radio and Infrared Frequency Spectrum. **Basics of wireless networks:** Wireless networks, wireless switching technology, wireless communication problem, wireless network reference model.	8
MODULE 2 **Wireless Local Area Network (WLAN):** Network components, Design requirements, WLAN architecture, Standards, WLAN Protocols- Physical Layer and MAC Layer, IEEE 802.11p, Security (WPA), Latest developments of IEEE 802.11 standards	8
MODULE 3 **Wireless Personal Area Network (WPAN)**: Network architecture and components, WPAN technologies and protocols, Application software; ZigBee (802.15.4): Stack architecture, Components, Topologies, Applications; Bluetooth (802.15.1): Protocol stack, Link types, security aspects, Network connection establishment, error correction and topology; LR-WPAN (IEEE 802.15.4)	8
MODULE 4 **Wireless Wide Area Network (WPAN):** Cellular networks, satellite networks, LAN versus WWAN, Interworking of WLAN and WWAN, WWAN applications.	8
MODULE 5 **Wireless Ad Hoc Networks:** Wireless Ad Hoc Networks, Mobile ad hoc networks, wireless sensor networks, wireless Mesh networks, Vehicular Ad Hoc Networks(VANETs)	8

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Course Outcomes: Upon successful completion of this course, student will be able to

CO232.1	Understand the existing wireless networks and connectivity issues
CO232.2	Describe the Wireless Local Area Network technology with its protocols and applications
CO232.3	Discuss the Wireless Personal Area Network technology with its protocols and applications
CO232.4	Describe the Wireless Wide Area Network technology with its protocols and applications
CO232.5	Understand Wireless Ad Hoc Networks and its technologies

Reference Books:

1. Dr. Sunil Kumar S. Manvi & Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Network conceptsand protocols", John Wiley India Pvt. Ltd, 1st edition, 2010
2. Vijay K.Garg, "Wireless Communications and Networking", Morgan Kaufmann, Publishers, 2009.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO232.1	-	1	1	-	-
CO232.2	1	1	1	1	-
CO232.3	1	1	1	1	-
CO232.4	1	1	1	1	-
CO232.5	1	1	1	-	1
Average	**1**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

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COURSE: AGILE TECHNOLOGY

Course Code:	23MCS233	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the fundamental principles of software project management.
CLO2	Have a good knowledge of responsibilities of project manager.
CLO3	Be familiar with the different methods and techniques used for project management.

CONTENTS	# of Hours
MODULE 1 **Selecting Software Development Life Cycle:** A generic process framework, Boehm's software engineering goal structure, waterfall model, Prototype Model, rapid Application Development (RAD), and Spiral Model, Selecting a software development model based on Characteristics of: requirements, Project team, User community, Project type and Risk.	8
MODULE 2 **Software Project Management:** Software project management process; Project Management skills, People management skills, P-CMM adaptation with CMM, Personality Models: The Myers-Briggs Type indicator(MBTI), Fundamental Interpersonal Relations Orientation-Behavior (FIRO-B), Common Software Quality Metrics.	8
MODULE 3 **Selecting a Project Team, Building WBS and Managing Project Risks:** Project office, project team, Building WBS for Software Project and developing Project Staffing Management Plan; Essential competencies of Project Manager, Managing Risks in Project: Risk assessment, Risk control and Risk mitigation.	8
MODULE 4 **Agile Project Management:** Values, Principles, Manifesto of Agile; Methodologies of Agile, Agile Governance, Understanding Critical Success Factors to Implement Agile PM: Resolving Risks, Myths, Challenges and benefits of APM.	8
MODULE 5 **Scrum Methodology and Implementation of SPRINT:** Roles and Responsibilities in Scrum, implementing Scrum process, estimating a Scrum Project, Tracking Scrum Projects, Communication in Scrum Projects; Sprints, how to Plan and Run an Effective Scrum - Sprint; Case Study of APM using Scrum for an Indian E-Governance project.	8

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

CO233.1	Explain Selecting Software Development Life Cycle
CO233.2	Explain Software Project Management
CO233.3	Discuss Selecting a Project Team, Building WBS and Managing Project Risks
CO233.4	Explain Agile Project Management concepts
CO233.5	Interpret Scrum Methodology and Implementation of SPRINT

Reference Books:

1. Quality Software Project Management by Robert. T.Futrell, Donald.F. Shafer & Linda.I. Shafer; Pearson Education-Prentice Hall.
2. Agile Project Management with Scrum (Developer Best Practices), by Ken Schwaber, Microsoft Press Publication, 2019

Mapping of CO-PO:

CO / PO	PO1	PO2	PO3	PO4	PO5
CO233.1	-	-	2	-	1
CO233.2	-	1	2	-	1
CO233.3	1	1	2	2	1
CO233.4	1	1	2	2	1
CO233.5	1	1	2	2	1
Average	**1**	**1**	**2**	**2**	**1**

Low-1: Medium-2: High-3

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COURSE: HUMAN COMPUTER INTERACTION

Course Code:	23MCS241	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Discuss the surveying the literatures of Human Computer Interaction
CLO2	Learn the knowledge through analysis and critical thinking to decide the interactions in HCI systems
CLO3	Analyze the Organizational issues and stake holder requirements by using Cognitive models, communication and collaboration models
CLO4	Design and Develop Web Interfaces by using Direct Selection, Contextual Tools, Overlays

CONTENTS	# of Hours
MODULE 1 **Introduction:** Importance of user Interface – definition, importance of good design, Benefits of good design. A brief history of Screen design. **The Graphical User Interface:** popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.	8
MODULE 2 **Design Process:** Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.	8
MODULE 3 **Screen Designing: Design goals** – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.	8
MODULE 4 **Windows:** New and Navigation schemes selection of window, selection of devices based and screen based controls.	8
MODULE 5 **Components**: Text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors. Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO241.1	discuss the basic components that which interact devices with computers.
CO241.2	Explain the window, device and screen based control navigation schemes
CO241.3	Describe the elements of good user interface design and effective GUI
CO241.4	Explain screen design principles for making good decisions based on technological constraints in interface design.
CO241.5	Describe the importance of human characteristics and understanding business functions

Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, Pearson Education, 3rd Edition, 2004.
2. Bill Scott and Theresa Neil, Designing Web Interfaces, OReilly, First Edition, 2008.
3. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, 2015.
4. Jenifer Tidwell, Designing Interfaces: Patterns for Effective Interaction Design, O'Reilly, 2nd Edition, 2011.
5. Wilbert O Galitz, The Essential Guide to User Interface Design, 3rd Edition. Wiley DreamaTech., India.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO241.1	-	1	2	-	2
CO241.2	-	1	2	-	2
CO241.3	-	1	2	-	2
CO241.4	2	1	2	2	2
CO241.5	2	1	2	2	2
Average	**2**	**1**	**2**	**2**	**2**

Low-1: Medium-2: High-3

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COURSE: EDGE AND FOG COMPUTING

Course Code:	23MCS242	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the basics of fog and edge computing.
CLO2	Have a basic understanding of the design and architecture of fog computing
CLO3	Design new services with fog computing.
CLO4	Gain knowledge on different real time applications in fog computing environment.
CLO5	Gain knowledge of how to design and implement mobile fog applications with 5Gnetwork

CONTENTS	# of Hours
MODULE 1 **Internet of Things (IoT) and New Computing Paradigms:** Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges. **Addressing the Challenges in Federating Edge Resources:** The Networking Challenges, The Management Challenge	8
MODULE 2 **Integrating IoT, Fog and Cloud Infrastructures:** Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use-Case Scenarios, Integrated C2F2T Literature by Metrics. **Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds:** Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog	8
MODULE 3 **Optimization Problems in Fog and Edge Computing:** Introduction ,Background / Related Work , Preliminaries , The Case for Optimization in Fog Computing , Formal Modeling Framework for Fog Computing , Metrics, Optimization Opportunities along the Fog Architecture , Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing , Optimization Techniques . **Middleware for Fog and Edge Computing:** Introduction , Need for Fog and Edge Computing Middleware , Design Goal ,State-of-the-Art Middleware Infrastructures , System Model , Proposed Architecture.	8
MODULE 4 **A Lightweight Container Middleware for Edge Cloud Architectures:** Introduction, Background/Related Work, Clusters for Lightweight Edge Clouds, Architecture Management – Storage and Orchestration, IoT Integration, Security Management for Edge Cloud, Fog Data Management.	8

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MODULE 5	8
Predictive Analysis to Support Fog Application Deployment: Motivating Example: Smart Building , Predictive Analysis with FogTorchΠ, Examples of Security and Privacy Issues in IoT , Security Concerns at Different Layers in IoT, Privacy Concerns in IoT Devices, IoT Security Breach Deep-Dive: Distributed Denial of Service (DDoS) Attacks on IoT Devices. **Fog Computing Realization for Big Data Analytics:** Introduction , Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation, Case Studies.	

Course Outcomes: Upon successful completion of this course, student will be able to

CO242.1	Explore the fundamentals and management in fog computing
CO242.2	Understand the design of fog architecture and networks slices.
CO242.3	Discuss about Optimization Problems in Fog and Edge Computing and its middleware.
CO242.4	Understand Lightweight Container Middleware for Edge Cloud Architectures and its security techniques.
CO242.5	Discuss about Predictive Analysis to Support Fog Application Deployment and big data analysis using different case studies.

Reference Books:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama.
2. Amir M. Rahmani, PasiLiljeberg, Jürgo-SörenPreden, Axel Jantsch, —Fog Computing inThe Internet of Things: Intelligence at the Edgel, Springer, 2018.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO242.1	1	1	1	-	1
CO242.2	1	1	1	-	1
CO242.3	1	1	1	2	1
CO242.4	2	1	1	2	1
CO242.5	2	1	1	2	1
Average	**2**	**1**	**1**	**2**	**1**

Low-1: Medium-2: High-3

Sleswamy

COURSE: AUGMENTED AND VIRTUAL REALITY

Course Code:	23MCS243	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Explain the Fundamentals of Virtual Reality
CLO2	Discuss the Various Interfaces - Input and output devices
CLO3	Illustrate the Augmented reality methods and mixed reality.
CLO4	Outline and Utilize various modeling techniques.
CLO5	Select simple AR/VR applications using the frameworks.

CONTENTS	# of Hours
MODULE 1 **Introduction:** The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. **Virtual Reality and Virtual Environment:** Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.	8
MODULE 2 **Input Devices:** (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. **Output Devices:** Graphics displays, sound displays & haptic feedback.	8
MODULE 3 **Augmented and Mixed Reality:** Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality. wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	8
MODULE 4 **Modeling:** Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management	8
MODULE 5 **Human Factors:** Methodology and terminology, user performance studies, VR health and safety issues. **Applications:** Medical applications, military applications, robotics applications, Engineering, Entertainment, Science, Training.	8

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Course Outcomes: Upon successful completion of this course, student will be able to

CO243.1	Explain various principles and concepts of virtual reality and its application.
CO243.2	Discuss input and output interfaces.
CO243.3	Discuss VR/AR technology differences
CO243.4	Apply appropriate method of geometric modelling
CO243.5	Implement Virtual Reality and Augmented Reality applications

Reference Books:

1. Virtual Reality Technology, Gregory C. Burdea& Philippe Coiffet, John, 2nd Edition, 2013 Wiley & Sons, Inc.
2. Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology", Wiley Interscience, 2nd Edition, 2006.
3. Alan B. Craig, "Understanding Augmented Reality", Concepts and Applications, Morgan Kaufmann,1st Edition, 2013
4. Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Merging Real and Virtual Worlds, 2005.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO243.1	1	1	-	-	1
CO243.2	1	1	2	-	1
CO243.3	1	1	2	-	1
CO243.4	1	1	2	1	1
CO243.5	1	1	2	1	1
Average	**1**	**1**	**2**	**1**	**1**

Low-1: Medium-2: High-3

COURSE: MINI PROJECT WITH SEMINAR

Course Code:	23MCS25	CIE Marks:	100
Hours/Week (L: T: P):	0:0:6	SEE Marks:	-
No. of Credits:	3	Examination Hours:	-

Guidelines:

1. Each student must select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
2. The mini project would be performed in-house.
3. The implementation of the project must be preferably carried out using the resources available in the department/college.
4. Execution of mini project should be carried out by students only under guidance of allotted.
5. 15-20 pages report to be submitted by students in prescribed guidelines. Presentation is for 10 minutes.
6. A demonstration and internal oral examination on the mini project should be done at the end of the semester.
7. Department may arrange demonstration with poster presentation of all mini projects.

Typical Evaluation pattern for the Course is shown in Table 1.

Table 1 : CIE Evaluation		
Components	**Marks**	**Total**
CIE		
Review Presentation 1	25	100
Review Presentation 1	25	
Report	50	

Mapping of PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
23MCS25	3	3	1	2	2

Low-1: Medium-2: High-3

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COURSE: DATA ANALYTICS USING TABLEAU LABORATORY

Course Code:	23MCSL26	CIE Marks:	50
Hours/Week (L: T: P):	1:0:2	SEE Marks:	50
No. of Credits:	2	Examination Hours:	3

Course Learning Objectives:

The course will enable students to:

CLO1	Become familiar with components and fields available in Tableau desktop.
CLO2	Get exposed to access data and connect data.
CLO3	Learn concepts of charts, plots, maps and mathematical functions to analyze real time data.
CLO4	Become familiar to build dashboard in Tableau.

CONTENTS
MODULE 1
Data Analytics: Introduction, types of Data Analysis, Real-world Data Analytics examples, tools and techniques for data Analytics. **Tableau:** What is Tableau? History of Tableau, Advantages and disadvantages of Tableau, Tableau architecture, Tableau Public and Tableau Desktop, Workspace, Connecting to data source, Files and folders, Tableau navigation, Terminologies, Data types, Data roles, Data aggregation, File types.
MODULE 2
Data Connection: Extracting data, Joining, Blending, Splits, Sorting, Fields operations. **Tableau calculations:** Operators, Functions, Numeric, string, date, table calculations, Level of Details expressions.
MODULE 3
Sort and Filter: Basic filters, Filter operations, Extract filters, Quick filters, Context filters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets.
MODULE 4
Charts: Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts. **Plots:** Scatter, Boxplot. **Maps:** Heat map, Tree map.
MODULE 5
Advanced Tableau: Dashboard, Formatting, Forecasting, Trend Lines.

List of Programs

Program 1

1. Create Calculated Fields on the dataset Sample-Superstores using Tableau.
   a) Display Absolute value of Profit for each Region and Sub-Category.
   b) Find sum of Maximum and Minimum Profit for each Region.
   c) Display the sum of Sales amount for each state. Label each State as 'Super Sales' if the Sales amount is greater than $100000, 'Good Sales' if the Sales amount is greater than $50000, 'Average Sales' if the Sales amount is greater than $10000, else as 'Bad Sales'.
   d) Demonstrate all types of Level of Details.
   e) Display the data for the Order_Date less than 2021 and Sales between 5000 and 10000.
   f) Convert the first 5 characters of State to Uppercase and plot it against Profit.
   g) Replace '-' with '(' and add ')' at the end of Customer ID and plot it against Sales.
   h) Display the Order Date in the format mm/dd/yyyy hh:mm:ss AM/PM.
2. Create a Dashboard considering atleast 4 charts from the above Calculated Fields.

Program 2

1. Create Calculated Fields on the dataset Amazon using Tableau.
   a) Round-off the Rating to zero decimal places and plot it against User Name.
   b) Obtain the plot of Rating versus first 4 characters of the Product Name.
   c) Capitalize only first letter of the Product Name and plot it against any measure.
   d) Determine if there are null values in the Rating and replace it with zero.
   e) Find the average Sales Price.
   f) Capitalize first character of every word under the Product Name and plot it against Discounted Price.
   g) Round-off the Actual Price to the nearest lowest integer and plot it against Product Names starting with 'AG'.
   h) Draw a stacked bar plot depicting the Product Id with series B07 against Rating.
2. Create a Dashboard considering atleast 4 charts from the above Calculated Fields.

Program 3

1. Demonstrate Data Extraction and different types of Joins on the dataset Sample-Superstores using Tableau.
2. Demonstrate the following charts using the dataset Sample-Superstores
   a) Dual Axis chart
   b) Motion chart
   c) Gantt chart
   d) Bullet chart
   e) Bubble chart
   f) Area chart
   g) Tree Map
   h) Heat Map
3. Create a Dashboard considering atleast 4 charts from the above Charts.

Program 4

1. Create Filters and analyze the data for the given dataset Coffee Chain using Tableau.
   a) What is the number of Sales in the state Nevada for the product Decaf Espresso?
   b) In California, which is the product with the highest and lowest profit?
   c) What is the contribution of sales in the East market for Decaf?
   d) In 2012, what is the contribution of sales in the East market for Decaf?
   e) What is the average profit for all the products starting with C?
   f) In 2013, identify the state with the highest profit in the West market.
   g) Identify the total expenses to sales ratio of the state with the lowest profit.
   h) In 2013, what is the percentage of total profit for Caffe Mocha falling under Major Market?
2. Create a Dashboard considering atleast 4 charts from the above Charts.

Program 5

1. Analyze the data for the given queries by creating charts for the dataset Coffee Chain.
   a) Create a Heat map for Product Type, State, and Profit. Identify which state has the lowest profit for Espresso.
   b) Using boxplot, identify which of the Espresso product has the highest distribution of sales.
   c) Create a bar chart with Product Type, Product, and Profit. Find the product and product type with the highest profit and the lowest profit.
   d) Create a scatter plot with State, Sales, and Profit. Draw your conclusion.
   e) Identify the state with the highest and the lowest profit in the market.
   f) What is the contribution of tea (in percentage) to the overall Profit?
   g) Identify through side-by-side circles, the minimum marketing for the Coffee Beans Colombian product.
   h) Using tree maps, identify the market with its size having maximum budget sales.
2. Create a Dashboard considering atleast 4 charts from the above Charts.

Program 6

1. Analyze the data for the given queries by creating charts for the dataset Office Supplies.
   a) Find the average units offered by the representative Richard.
   b) Find the total units offered by the representative Richard.
   c) What is the unit price of all items starting with P?
   d) Find the unit price of Binders in the West region.
   e) What is the average unit price of Pen Set in the East Region?
   f) Create a scatter plot depicting the relation between any 3 variables.
   g) Create a highlight table depicting the relation between any 3 variables.
   h) Create a stacked bar chart depicting the relation between region, item and units.
2. Create a Dashboard considering atleast 4 charts from the above Charts.

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Course Outcomes: Upon successful completion of this course, student will be able to

CO26.1	Apply design principles for Tableau visualization.
CO26.2	Use various functions and Filters in Calculations to design Charts in Tableau.
CO26.3	Design Dashboards to develop a strong, powerful data story.
CO26.4	Familiarize themselves well with current trends in Data Visualization through relevant case studies.

Reference Books:

1. Tableau 10 Business Intelligence Cookbook Book – Donabel Santos, Packt Publishing, 2016.
2. The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures, Dona M. Wong, W. W. Norton & Company.
3. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, Stephen Few, O'Reilly Media, 2013.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO26.1	2	-	2	1	1
CO26.2	2	-	2	1	1
CO26.3	2	-	2	1	1
CO26.4	2	-	2	1	1
Average	**2**	**-**	**2**	**1**	**1**

Low-1: Medium-2: High-3

SEMESTER – III

COURSE: LARGE LANGUAGE MODELS

Course Code:	23MCS31	CIE Marks:	50
Hours/Week (L: T: P):	4:0:0	SEE Marks:	50
Total Hours:	50	Examination Hours:	3
No. of Credits:	4		

Course Learning Objectives:

The course will enable students to:

CLO1	Know and learn large language models and its applications.
CLO2	Study different components used to design large language models.
CLO3	Improvise the performance of large language model by fine tuning methods.
CLO4	Evaluate the performance of large language models.

CONTENTS	# of Hours
MODULE 1 **Introduction:** Introduction to Language model, Advantages and disadvantage of language models, what is a large Language Model? Building Blocks of Language Models, Decoding Strategies, Language Model Architectures, Advantages of large language models.	10
MODULE 2 **Large Language Model Training:** Transformers, Components of a Generic Attention Mechanism, The Encoder Step-by-Step, The Decoder Step-by-Step. Pretraining Data: Simple Tokenization, Sub word Tokenization, Batching, scaling up pretraining data, Obtaining Web Pages, Scrape Texts, Clean Texts.	10
MODULE 3 **Emergent Behaviors of Large Language Models:** Emergent Behaviors of Pre-Trained Language models, Finetuning: Alignment, Dialog, Instruction Following, Zero-Shot Learning (Sentiment Classification), Zero-Shot Learning (Summarization), Few-Shot Learning (Machine Translation), prompt selection, Multi-Step Reasoning.	10
MODULE 4 **Automatic Evaluation of Large Language Models:** What is evaluation, Intrinsic vs extrinsic evaluation, automatic evaluation, General form of an evaluation metric, Sequences: Exact match, Word error rate, Perplexity, BLEU, ROUGE, addressing semantically similar words, character n-gram precision, character n-gram F-score, Bert-based similarity, BERT Score.	10
MODULE 5 **Parameter Efficient Tuning:** Parameter efficient tuning: Auto Prompt, Prompt tuning, Low Rank Adaption, adapters, compacters, Advantages of Adapter-Based Methods, Layer Freezing, Bias-terms Fine-tuning, Infused Adapter by Inhibiting and Amplifying Inner Activations, LLMs for Search Engines, LLMs for Music Generation.	10

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Course Outcomes: Upon successful completion of this course, student will be able to

CO31.1	Understand the preliminaries of language model and large language models.
CO31.2	Understand the training principles of Large Language Models
CO31.3	Interpret the concept of fine tuning of large language models.
CO31.4	Demonstrate the performance of large language models
CO31.5	Explain the parameter tuning of large language models and its applications

Reference Books:

1. Daniel Jurafsky & James H. Martin, Transformers and Large Language Models, Speech and Language Processing. Copyright © 2023
2. Alec Radford et al., "Improving Language Understanding by Generative Pre-Training, 2023.
3. Alec Radford et al., "Language Models are Unsupervised Multitask Learners", 2023.
4. Sebastian Gehrmann et al, "The GEM Benchmark: Natural Language Generation, its Evaluation and Metrics", 2023.
5. Brian Lester et al., "The Power of Scale for Parameter-Efficient Prompt Tuning"

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO31.1	1	1	1	-	1
CO31.2	1	1	1	-	1
CO31.3	2	1	1	2	1
CO31.4	2	1	1	2	1
CO31.5	1	1	1	-	1
Average	**2**	**1**	**1**	**2**	**1**

Low-1: Medium-2: High-3

Sleswamy

COURSE: GENERATIVE AI

Course Code:	23MCS321	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Impart the fundamentals of image formation, the major ideas, methods, and techniques of computer vision and pattern recognition
CLO2	Understand the workings of Generative AI and the diffusion models
CLO3	Develop an appreciation for various techniques of Computer Vision for Objectdetection and Face Recognition systems
CLO4	Provide the student with programming experience from implementing AI Chatbots

CONTENTS	# of Hours
MODULE 1 **Preprocessing of an image:** Basic concepts: pixel representation of an image, different color models, and their transformation, reading image in isolation and images from folder, Image preprocessing using Open CV, and Keras: reading multiple images from a directory, plotting, enhancement, filtering, re-scaling, morphological operations and image data augmentation.	8
MODULE 2 **Object Detection:** Introduction to object detection, Basic concepts: bounding box representation, sliding window methods, anchor boxes, grid cells, and non-maximum suppression (NMS). State-of-the-art architectures: R-CNN and YOLO. Evaluation metrics: Intersection over Union (IoU) and Mean Average Precision (mAP), Practical use case.	8
Module 3 **Generative AI Models:** Introduction to Gen AI, Architecture of GAN, Types of GANs, Variational Autoencoders and GANs (Variations of GANs – cGAN, wGAN, cyclic GAN, style tranfers using GAN), difference between VAEs & GANs, Image Captioning – LSTMs based, Transformers based. Deep Convolutional GAN(DCGAN), Steps for building DCGAN, Challenges in training the GANs, Evaluation metrics. Application-Synthetic Class Specific Image Generation Using GANs.	8
MODULE 4 **Normalizing Flows and Diffusion Models:** Diffusion process, Forward Diffusion, Reverse Diffusion, Training a diffusion model, Architecture, Guided Diffusion, Stable diffusion, Sampling Procedure,Practical Implementation.	8
MODULE 5 **AI Chatbots: Generative Videos:**AI Tools in Video Making, Working of AI Video Makers, Benefits of AI Video Makers, Popular AI Video Makers, Introduction to Synthesia, Features of Synthesia, Who should use Synthesia? Compatibilty of Synthesia,	8

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Pros and Cons of Synthesia, How to use Synthesia, Practical Case studies of Synthesia **Generative Codes:** Role of AI Tools in Programming, Copilot by Github, Working of Copilot, Copilot Compatibility, Advantages and Drawbacks of Copilot, How to use Copilot, How to Install the GitHub Copilot Extension, Converting Comments to Code using Copilot, Auto filling Repetitive Code using Copilot, Running Tests using Copilot, Navigatinging Unfamiliar Territory with Copilot, Creating an Application Entirely With Copilot, Some useful keyboard shortcuts for Github's Copilot.	

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

CO321.1	Apply the basic concepts of Image preprocessing for the real-life data.
CO321.2	Apply state-of-the-art architectures such as R-CNN and YOLO for object detection.
CO321.3	Apply Generative AI for text and image applications.
CO321.4	Apply diffusion models to understand the working of Removal of Noise.
CO321.5	Apply Generative AI for video and code applications.

Reference Books:

1. Deep learning for Computer Vision by Jason Brownlee.
2. Generative AI with Python and TensorFlow 2 by Joseph Babcock, Raghav Bali
3. Modern Generative AI with ChatGPT and OpenAI Models by Valentina Alto

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO321.1	1	2	1	2	2
CO321.2	1	2	1	2	2
CO321.3	2	2	1	2	2
CO321.4	2	2	1	2	2
CO321.5	2	2	1	2	2
Average	**2**	**2**	**1**	**2**	**2**

Low-1: Medium-2: High-3

Sleswamy

COURSE: ROBOTIC PROCESS AND AUTOMATION

Course Code:	23MCS322	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the basic concepts of RPA
CLO2	Describe IPA, where it can be applied and how it implemented
CLO3	Describe the different types of variables, Control Flow, and data manipulation techniques
CLO4	Understand Image, Text, and data Tables Automation
CLO5	Describe various types of Exceptions and strategies to handle

CONTENTS	# of Hours
MODULE 1 **RPA Foundations-** What is RPA - Flavours of RPA- History of RPA- The 0B Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- 0CR-Databases-APIs- Al-Cognitive Automation-Agile, Scrum, Kanban, and Waterfall DevOps-Flowcharts.	7
MODULE 2 **RPA Platforms-** What can RPA do? Benefits of RPA, Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.	8
MODULE 3 **Sequence, Flowchart, and Control Flow**-sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope Collections-Arguments - Purpose and use-Data table usage with examples Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa [with a step-by-step example.	8
MODULE 4 **Taking Control of the Controls-** Finding and attaching windows- Finding the control-Techniques for waiting for a control- Act on controls - mouse and keyboard activities-Working with UIExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points. **Handling User Events and Assistant Bots-** What are assistant bots? Monitoring system event triggers, Monitoring image and element triggers and Launching an assistant bot on a keyboard event.	9

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MODULE 5	8
Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking Screenshots-Debugging techniques- Collecting crash dumps- Error reporting, Managing and Maintaining the Code, Future of RPA.	

Course Outcomes: Upon successful completion of this course, student will be able to

CO322.1	Understand the basic concepts of RPA
CO322.2	Discuss various components and platforms of RPA
CO322.3	Summarize the different types of variables, control flow and data manipulation techniques
CO322.4	Understand various control techniques and OCR in RPA
CO322.5	Describe different types and strategies to handle exceptions

Reference Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, Publisher: A press
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018.
3. Frank Casale, Rebecca Dilla, Hieidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO322.1	1	1	1	-	1
CO322.2	2	2	1	2	1
CO322.3	2	2	1	2	1
CO322.4	2	2	1	2	1
CO322.5	2	2	1	2	1
Average	**2**	**2**	**1**	**2**	**1**

Low-1: Medium-2: High-3

COURSE: COMPUTER VISION

Course Code:	23MCS323	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Explore the fundamentals of image representation, its properties and segmentation
CLO2	Understand and explain image segmentation algorithms
CLO3	Explain basic pattern recognition methods and analyze image understanding algorithms
CLO4	Describe texture using various algorithms and implement applications that use object detection and segmentation

CONTENTS	# of Hours
MODULE 1 **Introduction:** The image, its representation and properties (brief review). Segmentation I: Border detection as graph searching, Border detection as dynamic programming, Border detection using border location information, Region construction from borders, Watershed segmentation	8
MODULE 2 **Segmentation II:** Mean shift segmentation, Active contour models Shape representation and description Object recognition: Knowledge representation, Statistical pattern recognition, Neural networks, Syntactic pattern recognition	8
MODULE 3 **Image understanding**: Image understanding control strategies, SIFT, RANSAC, Pattern recognition methods in image understanding, Scene labeling and constraint propagation, Semantic image segmentation and understanding	8
MODULE 4 **Texture:** Statistical texture description, Syntactic texture description methods	8
MODULE 5 **Applications of Object Detection and Segmentation**: Multi-object instance segmentation, Human pose detection, Crowd counting, Image colorization, 3D object detection with point clouds	8

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Course Outcomes: Upon successful completion of this course, student will be able to

CO323.1	Develop an insight of image representation, its properties and segmentation
CO323.2	Explain image segmentation algorithms and basic pattern recognition methods
CO323.3	Analyze image understanding algorithms
CO323.4	Explain texture using various algorithms
CO323.5	Implement applications that use object detection and segmentation

Reference Books:

1. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac, Roger Boyle, 4th Edition, CENGAGE Learning, 2015.
2. Computer Vision: A Modern Approach, David A. Forsyth, Jean Ponce, 2nd Edition, Pearson Education India, 2015.
3. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2nd Edition, 2022.
4. Modern Computer Vision with PyTorch, V Kishore Ayyadevara, Yeshwanth Reddy, 1st Edition, Packt Publishing, 2020.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO323.1	1	2	1	2	2
CO323.2	2	2	1	2	2
CO323.3	2	2	1	2	2
CO323.4	2	2	1	2	2
CO323.5	2	2	1	2	2
Average	**2**	**2**	**1**	**2**	**2**

Low-1: Medium-2: High-3

COURSE: CYBER SECURITY AND DIGITAL FORENSICS

Course Code:	23MCS331	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Provide the basic knowledge on Computer Forensics.
CLO2	Understand cybercrime and the laws governing cybercrime.
CLO3	Comprehend the contextual need of cybercrime investigations.
CLO4	Investigate the use of tools used in cyber forensics.

CONTENTS	# of Hours
MODULE 1 **Understanding Cyber Crime:** Indian IT Act 2008 and amendments, Computer Forensics and Investigation as a profession, Understanding computer forensics, Preparing a computer investigation, Taking a systematic approach, Procedures for corporate high tech investigations, Understanding data recovery workstations and software	8
MODULE 2 **Cyber Crime in Devices:** Introduction, Proliferation of mobile and wireless devices, Credit card fraud in the mobility era, Challenges posed by mobile devices, Registry settings, Attacks on mobile/cell phones, Security implications and Measures for organizations in handling mobile devices, Organizational security policies and measures in mobile computing era, Laptops	8
MODULE 3 **Data Acquisition:** Understanding storage formats for digital evidence, Determining the best acquisition method, Contingency planning for image acquisitions, Using acquisition tools, validating Data acquisition, Using remote network acquisition tools, Computer forensics Analysis and Validation –Determining what data to collect and analyze, Validating forensic data, Addressing Data Hiding Techniques, Performing remote acquisitions.	8
MODULE 4 **Computer Forensics Tools:** Evaluating Computer Forensic tool needs, Computer Forensics software tools, Computer Forensics Hardware tools, Validating and testing Forensic software, Recognizing a graphics file, Understanding data compression, locating and recovering graphics files, Identifying unknown file formats, Understanding copyright issues with graphics.	8
MODULE 5 **Tools and Methods:** Introduction, proxy servers and Anonymizers, Phishing, Password cracking, Keyloggers and spywares, virus and worms, Trojan Horses and back doors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer overflow, Identity Theft	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO331.1	Discuss the Indian IT Act 2008 and its Amendments.
CO331.2	Describe the organizational methods and policies for cyber crime handling in mobile and wireless devices..
CO331.3	Explain the Data storage and acquisition methods for digital evidence.
CO331.4	Describe the computer forensic tools and their usage.
CO331.5	Discuss the different tools and techniques used in cyber crime

Reference Books:

1. Dr.Surya Praksh Tripathi,Ritendra Goyal Praveen Kumar Shukla, Introduction to Information Security and cyber laws, Dream tech Press, 2015.
2. I.A.Dhotre, Cyber Forensics, Technical Publications 1st Edition, 2016.
3. Sunith Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crime, computer forensics and legal perspectives, Wiley India, 2013.
4. Thomas J Moubray, John, Cyber Security:Managing Systems,Conducting Testing,and Investigating Inrusions, Wiley, 2014.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO331.1	-	-	1	3	1
CO331.2	-	-	1	3	1
CO331.3	2	1	1	2	1
CO331.4	2	1	1	2	1
CO331.5	2	1	1	3	1
Average	**2**	**1**	**1**	**3**	**1**

Low-1: Medium-2: High-3

COURSE: MULTICORE ARCHITECTURE AND PROGRAMMING

Course Code:	23MCS332	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Identify performance related parameters in the field of multicore Architecture.
CLO2	Explain fundamental concepts of parallel programming and its design issues.
CLO3	Solve the issues related to multiprocessing and suggest solutions.

CONTENTS	# of Hours
MODULE 1 **Introduction to Multi-core Architecture:** Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms, Understanding Performance, Amdahl"s Law, Growing Returns: Gustafson"s Law. **System Overview of Threading**: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization	8
MODULE 2 **Fundamental Concepts of Parallel Programming:** Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You"ll Face,Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error DiffusionAlgorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. **Threading and Parallel Programming Constructs:** Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features.	8
MODULE 3 **Threading APIs:** Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.	8
MODULE 4 **Open MP:** A Portable Solution for Threading: Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier	8

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and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out,Protecting Updates of Shared Variables, Intel Task queuing Extension to Open MP, Open MP Library Functions, Open MP Environment Variables, Compilation, Debugging, performance.	
MODULE 5 **Solutions to Common Parallel Programming Problems:** Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO332.1	Identify performance related parameters in the field of multicore Architecture.
CO332.2	Explain fundamental concepts of parallel programming and its design issues.
CO332.3	Solve the issues related to multiprocessing and suggest solutions.
CO332.4	Understand the concept of multi-threading and OPENMP.
CO332.5	Illustrate OpenMP and programming concept.

Reference Books:

1. Shameem Akhter and Jason Roberts: Multicore Programming, Increased Performance through Software Multi-threading, Intel Press, 2006.
2. Hennessey and Patterson: Computer Architecture A Quantitative Approach, 4th Edition, Elsevier, 2012.
3. Calvin Lin, Lawrence Snyder: Principles of Parallel Programming, Pearson Education, 2009.
4. Michael J. Quinn: Parallel Programming in C with MPI and OpenMP, Tata McGraw Hill, 2004.

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO332.1	1	1	1	-	1
CO332.2	1	1	1	-	1
CO332.3	1	1	1	-	1
CO332.4	1	1	1	1	1
CO332.5	1	1	1	1	1
Average	**1**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

COURSE: QUANTUM COMPUTING

Course Code:	23MCS333	CIE Marks:	50
Hours/Week (L: T: P):	3:0:0	SEE Marks:	50
Total Hours:	40	Examination Hours:	3
No. of Credits:	3		

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the fundamental principles of quantum computing.
CLO2	Understand the building blocks of a quantum computer.
CLO3	Describe the principles, quantum information and limitation of quantum operations formalizing.
CLO4	Understand implementations of quantum computers
CLO5	Explain distance measures for processing quantum information

CONTENTS	# of Hours
MODULE 1 **Fundamental concepts:** Global Perspectives, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum Information.	8
MODULE 2 **Quantum computation:** Quantum Circuits – Quantum algorithms, Single qubit operations, Control Operations, Measurement, Universal Quantum Gates.	8
MODULE 3 **Quantum search algorithms:** The quantum search algorithm, quantum search as a quantum simulation, Quantum counting, Speeding up the solution of NP-complete problems.	8
MODULE 4 **Quantum computers:** Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer.	8
MODULE 5 **Distance Measures for quantum information:** Distance measures for classical information, how close are two quantum states, how well does a quantum channel preserve information.	8

Course Outcomes: Upon successful completion of this course, student will be able to

CO333.1	Understand the basics of quantum principles
CO333.2	Explain quantum circuits and their implementation
CO333.3	Understand quantum search algorithms and its simulation
CO333.4	Explain the realizations of quantum computers
CO333.5	Understand distance measures used in quantum information processing

Reference Books:

1. Micheal A. Nielsen. & Issac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, First south Asia Edition, 2013.
2. Parag K Lala, Quantum Computing, A Beginners Introduction, McGraw Hill Education (India), First Edition.
3. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Reprint Edition

Mapping of CO-PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO333.1	1	1	-	-	1
CO333.2	1	1	-	1	1
CO333.3	1	1	-	1	1
CO333.4	1	1	-	-	1
CO333.5	1	1	-	-	1
Average	**1**	**1**	**-**	**1**	**1**

Low-1: Medium-2: High-3

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COURSE: PROJECT PHASE-I

Course Code:	23MCS34	CIE Marks:	100
Hours/Week (L: T: P):	0:0:6	SEE Marks:	-
No. of Credits:	3	Examination Hours:	-

GUIDELINES:

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
3. Students update their progress on weekly basis.
4. The allocation of the guides shall be preferably in accordance with the expertise of the faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from Internal Guide and Head of the Department.
6. Students have to complete Major Project Phase-I before starting Major Project Phase -II. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size12.
7. The Continuous Internal Examination marks shall be awarded by the project guide.
8. The evaluation criteria shall be as per the rubrics as follows- The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase-I, shall be based on the evaluation of the Project review 1 and 2 (project presentation skill and question and answer session) and project work phase -1- Report (covering Literature Survey, Problem identification, Objectives and Methodology), in the ratio 25:25:50.

Typical Evaluation pattern for the Course is shown in Table 1.

Table 1: CIE Evaluation

Components	Marks	Total
CIE		
Review 1	25	100
Review 2	25	
Report	50	

Mapping of PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
23MCS34	3	3	3	3	2

Low-1: Medium-2: High-3

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COURSE: SOCIETAL PROJECT

Course Code:	23MCS35	CIE Marks:	100
Hours/Week (L: T: P):	0:0:6	SEE Marks:	-
No. of Credits:	3	Examination Hours:	-

Societal Project: Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems. CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE examination for this course.

Typical Evaluation pattern for the Course is shown in Table 1.

Table 1: CIE Evaluation

Components	Marks	Total
CIE		
Review 1	25	100
Review 2	25	
Report	50	

Mapping of PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
23MCS35	3	3	3	3	2

Low-1: Medium-2: High-3

COURSE: INTERNSHIP

Course Code:	23MCSI36	CIE Marks:	50
No. of Credits:	6	SEE Marks:	50
Examination Hours: 3			

GUIDELINES:

1. The duration of the internship shall be for a period of 6 weeks on full time basis after II semester final exams and before the commencement of III semester.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry/organizations.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be cream color.
7. The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry /Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship

8. A Semester End Examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent examination after satisfying the internship requirements.
9. The CIE marks of Internship shall be awarded by a committee comprising of the guide, senior professor, and the supervisor from industry/organisation. The committee shall assess the presentation and the progress reports in two reviews.
10. SEE marks shall be awarded by a committee comprising of Guide, and External Examiner (Domain Expert). The SEE marks awarded for internship shall be based on the evaluation of Internship Report, Presentation skill and performance in Question-and Answer session in the ratio 50:25:25. Evaluation shall be done in batches, not exceeding 6 students per batch.

The evaluation criteria shall be as per the rubrics given below:

Sl. No.	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries and Industrial Practices, ability to comprehend the functioning of the organization/ departments.	50%
Review-II	Importance of Project management, environment, and sustainability. Presentation skills and report writing.	50%

Mapping of PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
23MCSI36	3	3	3	3	2

Low-1: Medium-2: High-3

SEMESTER IV

COURSE: PROJECT WORK PHASE-II

Course Code:	23MCS41	CIE Marks:	100
Hours/Week (L: T: P):	0:0:9	SEE Marks:	100
No. of Credits:	18	Examination Hours:	3

GUIDELINES:

1. Major Project Phase-II is continuation of Phase-I.
2. The student needs to complete the project work in terms of methodology, algorithm, development, experimentation, testing and analysis of results.
3. It is desirable that the student should present/publish the work in National/International conferences or Journals
4. The reports shall be printed on A4 size with1.5 spacing and Times New Roman with font size12, outer Cover of the report (wrapper) has to be Cream color.
5. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report (Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication), Demonstration and project review 1, 2 and 3 (presentation skill and question and answer session) in the ratio 50:25:25.
6. Contribution to the project and-the performance of each student shall be assessed in semester end examination (SEE) conducted at the department.

Typical Evaluation pattern for the Course is shown in Table 1.

Table 1: CIE and SEE Evaluation

Components	Marks	Total	
CIE			
Review 1	25	100	200
Review 2	25		
Review 3	50		
SEE			
Semester End Viva	100	100	

Mapping of PO:

CO/PO	PO1	PO2	PO3	PO4	PO5
23MCS41	3	3	3	3	3

Low-1: Medium-2: High-3

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