SCHEME OF INSTRUCTION AND SYLLABI

Master of Technology

A TWO YEAR PG Program

in

M.TECH-COMPUTER SCIENCE AND ENGINEERING

(AICTE Model Curriculum with effect from AY 2023-24)

(R–23 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous Institution under UGC, Affiliated to Osmania University)

Department of Electronics and Communication Engineering

Accredited by NBA and NAAC-UGC

Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

OUR MOTTO: SWAYAM TEJASWIN BHAVA

VISION and MISSION of the INSTITUTE

Vision

To be a centre of excellence in technical education and research.

Mission

To address the emerging needs through quality technical education and advanced research.

VISION and MISSION of the DEPT. of COMPUTER SCIENCE AND ENGINEERING

VISION

To become a center of excellence in the field of Computer Science and Engineering that produces innovative, skillful, socially responsible and ethical professionals.

MISSION

1. To provide a curriculum that balances engineering fundamentals, modern technologies and research.
2. To provide opportunities for solving real world problems.
3. To provide opportunities for overall personal and social skill development.

M.Tech (CSE) Program Educational Objectives (PEO's)

1. Will be able to practice their profession with confidence and global competitiveness by making intellectual contributions.
2. Will pursue a life-long career of personal and professional growth with superior work ethics and character.
3. Will be engaged in research leading to innovations/products or become a successful entrepreneur.

M.Tech (CSE) Program Outcomes (PO's)

1. An ability to independently carry out research /investigation and development work to solve practical problems
2. An ability to write and present a substantial technical report/document
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4. An ability to pursue higher studies or provide solutions for complex real world problems.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
(AICTE MODEL CURRICULUM WITH EFFECT FROM AY 2023-24)

M.TECH (CSE)

SEMESTER–I

S.No	Course Code	Title Of Course	Scheme Of Instructions			Duration Of SEE In Hours	Scheme Of Examination		
			Hours Per Week				Maximum Marks		Credits
			L	T	P/D		CIE	SEE	
		THEORY							
1	23CSC101	Mathematical Foundation of Computer Science	3	-	-	3	40	60	3
2	23CSC 102	Advanced Algorithm	3	-	-	3	40	60	3
3	23CSEXXX	Elective -I	3	-	-	3	40	60	3
4	23CSEXXX	Elective -II	3	-	-	3	40	60	3
5	23CSC 103	Research Methodologies in Computer Science and IPR	2	-	-	2	40	60	2
6	23XXXXX	Audit Courses-1	2	-	-	2	-	50	Non Credit
PRACTICAL									
7	23CSC 104	Laboratory 1 (Advanced Algorithm lab)	-	-	3	-	50	-	1.5
8	23CSEXXX	Laboratory 2 (Based on Elective-I)	-	-	3	-	50	-	1.5
	Total		**16**	**-**	**6**	**-**	**300**	**350**	**17**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
(AICTE MODEL CURRICULUM WITH EFFECT FROM AY 2023-24)

M.TECH (CSE)

SEMESTER – II

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	23CSC105	Advanced Databases	3	--	--	3	40	60	3
2	23CSC106	Soft Computing	3	--	--	3	40	60	3
3	23CSEXXX	Elective -III	3	--	--	3	40	60	3
4	23CSEXXX	Elective -IV	3	--	--	3	40	60	3
5	20XXXXX	Audit Course 2	2	--	--	2	--	50	Non Credit
PRACTICALS									
7	23CSC 107	Laboratory 3 (Advanced Databases & Soft Computing Lab)	-	-	3	--	50	--	1.5
8	23CSEXXX	Laboratory 4 **(Based on Electives III)**	-	-	3	--	50	--	1.5
9	23CSC 108	Mini Projects with seminar	-	-	4	--	50	--	2
Total			**14**	**--**	**10**	**--**	**310**	**290**	**17**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

- **Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
(AICTE MODEL CURRICULUM WITH EFFECT FROM AY 2023-24)

M.TECH (CSE)

SEMESTER-III

S.No	Course Code	Title of the Course	Scheme of Instruction Hours per Week			Duration of SEE in Hours	Scheme of Examination		
							Maximum Marks		Credits
			L	T	P		CIE	SEE	
THEORY									
1	23CSC 109	Distributed Cloud Computing	2	-	-	3	40	60	2
2	23CSEXXX	Elective -V	3	-	-	3	40	60	3
3	23CSXXX	Open Elective-VI	3	-	-	3	40	60	3
4	23CSC 110	Dissertation Phase – I	-	-	20	-	100	-	10
TOTAL			**8**	**-**	**20**	**-**	**220**	**180**	**18**

****Students going for Internship / Industrial project, may complete these courses through NPTEL/ MOOCs**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

- **Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
(AICTE MODEL CURRICULUM WITH EFFECT FROM AY 2023-24)

M.TECH (CSE)

SEMESTER- IV

S.No	Course Code	Title of the Course	Scheme of Instruction Hours per Week			Duration of SEE in Hours	Scheme of Examination		
							Maximum Marks		Credits
			L	T	P		CIE	SEE	
THEORY									
1	23CSC 111	Dissertation Phase – II	0	0	32	3	100	100	16
TOTAL			**0**	**0**	**32**	**-**	**100**	**100**	**16**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

- **Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.**

LIST OF ELECTIVES

Type of Electives	Course Code	Title Of Course
ELECTIVE-I	23CSE101	Machine Learning
	23CSE102	Data Preparation and Analysis
	23CSE103	Computer Graphics
	23CSE104	Full Stack Development
	23CSE105	Software Defined Networks
ELECTIVE-I Lab	23CSE106	Machine Learning Lab
	23CSE107	Data Preparation and Analysis Lab
	23CSE108	Computer Graphics Lab
	23CSE109	Full Stack Development Lab
	23CSE110	Software Defined Networks Lab
ELECTIVE-II	23CSE111	Artificial Intelligence
	23CSE112	Data Mining and Data Warehousing
	23CSE113	Human Computer Interaction
	23CSE114	Software Architectures
	23CSE115	Parallel & Distributed Systems
ELECTIVE-III	23CSE116	Deep Learning
	23CSE117	Big Data Analytics
	23CSE118	Artificial Intelligence For Robotics
	23CSE119	Secure Software Design & Enterprise Computing
	23CSE120	Advanced Wireless & Mobile Networks
ELECTIVE-III Lab	23CSE121	Deep Learning Lab
	23CSE122	Big Data Analytics Lab
	23CSE123	Artificial Intelligence For Robotics Lab
	23CSE124	Secure Software Design & Enterprise Computing Lab
	23CSE125	Advanced Wireless & Mobile Networks Lab
ELECTIVE-IV	23CSE126	Natural Language Processing
	23CSE127	Advanced Databases (Parallel, Multimedia, Distributed, NoSQL)
	23CSE128	Virtual, Augmented, Mixed & Extended Reality
	23CSE129	Block Chain Technology
	23CSE130	High Performance Computing
ELECTIVE-V	23CSE131	Computer Vision
	23CSE132	Cloud IoT
	23CSE133	Game Design & Development
	23CSE134	Design Patterns
	23CSE135	Cyber Security
Open ELECTIVE VI	23CSO101	Business Analytics
	23MEO101	Industrial Safety
	23MEO102	Introduction to Optimization Techniques
	23MEO103	Composite Materials
	23MEO 104	Alternative energy sources
	23MEO 105	Computational methods
	23CEO101	Cost Management of Engineering Projects
	23EEO101	Waste to Energy
	23PYO 01	History of Science and Technology

Audit Courses -1&2

List of Audit Courses -1&2

S.No	Course Code	Title Of Course
1	23EGA101	English for research paper writing
2	23CEA101	Disaster mitigation and management
3	23EEA101	Sanskrit for technical knowledge
4	23ECA101	Value education
5	23EGA102	Indian constitution & fundamental rights
6	23ADA101	Pedagogy studies
7	23EGA103	Stress Management by Yoga
8	23EGA104	Personality Development through Life Enlightenment Skills.

23CSC101

MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the mathematical fundamentals that are pre requisite for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
2. To develop the understanding of the mathematical and logical basis of various modern techniques in information technology like machine learning, programming language design, and concurrency.
3. To study various Graph Theory problems.

Course Outcomes:

After Completion of the course Students will be able to:

1. Understand the basic notions of discrete and continuous probability.
2. Apply the methods of statistical inference, and learn application of sampling distributions in Data mining and Machine Learning.
3. Apply statistical analysis to algorithmic problems of simple to moderate complexity indifferent domains.
4. Model different applications of Computer science as graph theory problems

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	3	-	1	-	-	-	-	-
CO 2	3	2	1	2	-	-	-	-	-
CO 3	3	2	1	1	-	-	1	-	1
CO 4	3	3	1	2	-	-	-	-	-
CO 5	3	2	1	2	2	-	1	-	2
CO 6	3	3	1	2	-	-	-	-	-

UNIT - I

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

UNIT - II

Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**.**

UNIT - III

Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal component analysis**,** The problem of over fitting model assessment.

UNIT - IV

Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

UNIT-V

Number Theory: Elementary number theory, fundamental theorem of arithmetic, gcd, unique factorization, Euler's function, modular arithmetic, Fermat's little theorem, Chinese remainder theorem, modular exponentiation, RSA public key encryption.

Text Books:

1. John Vince, Foundation Mathematics for Computer Science, Springer, 2015.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and ComputerScience Applications, Wiley, 2001.

Suggested Readings

1. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms andProbabilistic Analysis, 2005.
2. Alan Tucker, Applied Combinatorics, Wiley, 2012.

23CSC 102

ADVANCED ALGORITHMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites: UG level course in Algorithm Design and Analysis.

Course Objectives:
This course aims to:
1. Introduce advanced methods of choosing, designing and analyzing algorithms.
2. Familiarize with basic paradigms and data structures used to solve advanced algorithmic problems.
3. Understand different classes of problems concerning their computation difficulties.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Define and discuss the different problems solved by using algorithmic paradigms.
2. Apply the suitable data structure for solving a problem using various strategies.
3. Differentiate the complexities of a problem solved in various approaches.
4. Evaluate various algorithmic design techniques.
5. Design appropriate mathematical notation to solve a problem using algorithmic paradigms.
6. Develop solutions for real world problem.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	-	-	-	-	1	-	-
CO 2	3	3	-	-	-	-	1	-	-
CO 3	3	3	-	-	-	-	1	-	-
CO 4	3	3	-	-	-	-	1	-	-
CO 5	3	3	-	-	-	-	1	-	-
CO 6	3	3	1	1	-	-	1	-	-

UNIT - I
Introduction to Data Structures: Preliminary Data structures- Stack, Queue, Linked List, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.
Sorting: Review of various sorting algorithms, topological sorting.
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, Shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components.

UNIT - II
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT - III
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of atriangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT - IV
Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm- Optimal Binary Search Tree, 0/1 Knapsack Problem, Longest Common Subsequence, Matrix Chain Multiplication.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

UNIT-V
Linear Programming: Geometry of the feasibility region and Simplex algorithm **NP-completeness:** proof of NP-hardness and NP-completeness-Clique Problem, Vertex-Cover Problem, Subset-Sum Problem.
Approximation algorithms: Introduction, Vertex-Cover Problem

Textbooks:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition,The MIT Press, 2009.

Suggested Readings:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", Pearson Addison-Wesley Publication, Originally published on 1974.
2. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson Addison-Wesley Publication, 2009.

Online Resources :

1. https://nptel.ac.in/courses/106104019/

23CSE101

MACHINE LEARNING

Elective-I

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: UG level course in probability, linear algebra and calculus. Any Programming experience is essential.

Course objectives:

The objectives of this course are

1. Introduce students to state-of-the-art methods.
2. Expose to Modern programming tools for data analysis.
3. To study various sampling and classification problems

Course Outcomes:

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

1. Identify complexity of Machine Learning algorithms and their limitations.
2. Recognize the underlying mathematical relationships within and across Machine Learning algorithms and their paradigms.
3. Design and implement machine learning solutions to classification, regression, and clustering problems.
4. Evaluate and interpret the results of the algorithms.
5. Develop an appreciation for what is involved in learning from data.
6. Apply graphical models for probabilistic reasoning.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	3	-	1	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-
CO3	3	2	1	1	-	-	1	-	1
CO4	3	3	1	2	-	-	-	-	-
CO5	3	2	1	2	2	-	1	-	2
CO6	3	3	1	2	-	-	-	-	-

UNIT - I

Introduction: Learning, Types of Machine Learning. Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm. Learning with Trees: Constructing Decision Trees, CART, Classification Example.

UNIT - II

Linear Discriminants: The Perceptron, Linear Separability, Linear Regression.
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation SUPPORT Vector Machines: Optimal Separation, Kernels.

UNIT - III

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison.

UNIT - IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming.
Ensemble learning: Boosting, Bagging, Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis.

UNIT-V

Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.. Reinforcement Learning - The Learning Task, Q Learning.

Textbooks:

1. Tom M. Mitchell, "Machine Learning", Mc Graw Hill, 1997
2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.

Suggested Readings:

1. Margaret H Dunham, "Data Mining", Pearson Edition., 2003.
2. GalitShmueli, Nitin R Patel, Peter C Bruce, "Data Mining for Business Intelligence", Wiley India Edition, 2007
3. RajjanShinghal, "Pattern Recognition", Oxford University Press, 2006.

Online resources:

1. NPTEL https://nptel.ac.in/courses/106106139/.

23CSE102

DATA PREPARATION AND ANALYSIS
Elective-I

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Computer Programming, Data Visualization, Spreadsheet Applications, Statistics, Communication, Storytelling, and Time Management.

Course Objectives:

The objectives of this course are

1. Identify data gathering and preparation techniques for industrial and scientific applications.
2. Apply exploratory data analysis techniques to develop meaningful data visualizations.
3. Analyze various statistical significance based testing mechanisms and apply them to deal with real- world problems.

Course Outcomes:

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

1. Identify and analyze various data gathering and preparation techniques to format, parse and transform data as required.
2. Apply data cleaning techniques on various data sets to perform consistency check, transformation, and segmentation processes.
3. Apply exploratory data analysis techniques to perform descriptive and comparative statistics on data.
4. Analyze different visualization techniques and apply the suitable one to deal with real-world problems.
5. Apply correlations, connectivity, and interactivity techniques on different data items for any given dataset.
6. Analyze various statistical significance based testing mechanisms and apply them to build regression models.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	2	1	1	1	1	-	-
CO 2	3	3	2	1	1	1	-	3	3
CO 3	3	3	3	1	-	1	-	-	-
CO 4	3	3	3	1	1	1	-	-	-
CO 5	3	3	3	1	-	1	-	-	-
CO 6	3	3	3	1	1	1	-	-	-

UNIT – I

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues.

UNIT - II

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.

UNIT - III

Exploratory Analysis: Descriptive and comparative statistics, Clustering and Association, Hypothesis generation.

UNIT - IV

Visualization: Designing visualizations, Time series, Geo-located data, Correlations and connections, Hierarchies and networks, interactivity.

UNIT-V

Statistical Significance, ANOVA, T-test, Building machine learning Regression models.

Textbook:

1. Making sense of Data : "A practical Guide to Exploratory Data Analysis and Data Mining", by Glenn J. Myatt, 2007.
2. Trochim, W. M. K. “Data Preparation” Research Methods Knowledge Base 2nd Edition. Accessed 2/24/09.

Suggested Readings:

1. Data Analytics Made Accessible by Dr. Anil Maheshwari.
2. Numsense! Data Science for the Layman: No Math Added by Annalyn Ng and Kenneth Soo.

Online Resources:

1. https://www.safaribooksonline.com/library/view/visualizingdata/9780596514556/ch08.html.
2. https://www.scribd.com/document/54993779/Making-Sense-of-Dataa-Practical-Guide-to-Exploratory- Data-Analysis-and-Data-Mining.

23CS E103

COMPUTER GRAPHICS
Elective-I

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: UG level Course in Linear Algebra and Probability.

Course Objectives:

The objectives of this course are

1. To introduce students the fundamental concepts in computer graphics.
2. To introduce to a range of computer graphics techniques and algorithms covering 2D graphics, 3D graphics,
3. To focuses on key algorithmic techniques and mathematical foundations, not on specific tools.
4. To Study the necessary math background, raster image formats, affine transformations, rendering algorithms, data structures for 2D and 3D curves, surfaces, and volumes, textures and texture mapping, shading and reflection models.

Course Outcomes:

On Successful completion of the course, students will be able.

1. To understand computer graphics system, design algorithms and two-dimensional transformations.
2. To Apply clipping, three-dimensional graphics and three dimensional transformations.
3. To apply modelling, rendering, shading Algorithms
4. To apply various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
5. To model by mapping computer graphics and geometrical transformation in multidisciplinary field of engineering.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	3	-	1	-	2	3	3
CO 2	3	3	3	-	-	-	2	3	3
CO 3	3	3	3	2	-	-	2	3	3
CO 4	3	3	3	2	-	-	2	3	3
CO 5	3	3	3	2	-	-	2	3	3

UNIT – I

Raster Graphics System and its Working: Line-Drawing Algorithms (DDA and Bresenham's algorithms), Polygon Filling, 2-D Transformations.

UNIT – II

Fundamentals of 3-D Graphics: Projections (Parallel projection and Perspective projection), 3- D Transformations, Bezier curves and B-spline curves, Visible-Surface Detection Methods (Painter's algorithm and Z-buffer method).

UNIT – III

Structures and Hierarchical Modeling: Structure Concepts, Editing Structures, Basic Modeling Concepts, Hierarchical Modeling with Structures.

UNIT – IV

Graphics Standards: GKS, PHIGS-their salient features. OpenGL-the new graphics standard, important OpenGL functions, advantages of OpenGL, Sample graphics programs showing the use of OpenGL functions.

UNIT – V

Fractals: Fractal-Geometry Methods, Fractal-Generation Procedures, Classification of Fractals, Fractal Dimension, Geometric Construction of Deterministic Self-Similar Fractals, Geometric Construction of Statistically Self-Similar Fractals. Affine Fractal-Construction methods, Random Midpoint-Displacement Methods, Controlling Terrain Topography, Self-squaring Fractals, Self inverse Fractals.

Textbook:

1. Hearn Donald, Pauline Baker M., Computer Graphics, Pearson Education, 2 nd Edition, 1997.
2. Foley, Vandam, Feiner, Hughes, Computer Graphics - Principles & Practice, Addison- Wesley, 2nd Edition, 1996.

Suggested Readings:

1. David F Rogers, Procedural Elements for Computer Graphics, McGraw-Hill, 2 nd Edition, 2001
2. Hill, Jr. & Kelley by F. S.,Hill Jr,Kelley Jr,Stephen M, Computer Graphics Using OpenGL, PHI, 3 rd Edition, 2009.

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Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs97/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee23/preview

23CSE104

FULL STACK DEVELOPMENT
Elective – I

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
The objectives of this course are
1. To provide good understanding of latest web technologies on client side components like React JS and Angular2
2. Acquire knowledge on web frameworks to develop server side web applications like Node.js and Express
3. To develop innovative web applications using various technologies.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the database connectivity and application servers.
2. Explore the type of forms with validations using ReactJS.
3. Utilize Express framework to develop responsive web applications.
4. Demonstrate the architecture and file system of NodeJs
5. Identify the significance of component intercommunication with Angular2
6. Adapt MEAN or MERN stack to implement a real-time web application.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	1	1	-	-	-	-	-	1
CO 2	2	3	3	-	-	-	2	-	1
CO 3	2	3	3	-	-	-	2	-	1
CO 4	2	-	3	-	-	-	2	-	1
CO 5	2	-	3	-	-	-	2	-	1
CO 6	3	3	3	-	-	-	3	-	1

UNIT – I
Introduction to Full stack development and NoSQL.
MongoDB: Basics, Configuring Server and Client, MongoDB Compass, Creating Database, MongoDB Commands, MongoDB CRUD Operations

UNIT – II
Introduction to ReactJS: React Components, React State and Props.
Component intercommunication: Component Composition, pass data from parent to child, pass data from child to parent, Fetching data API using axioms, Types of forms, Form Validations, Posting Data, React Router, Building & Deploying React App.

UNIT – III
Building an Express web application: Introduction to Express, Installation of Express, Create first Express application, the application request and response objects, configuring an Express application, rendering views, Authentication, Authorization.

UNIT – IV
NodeJs: Introduction, NodeJS Features and Drawbacks, setup Environment for NodeJs, NodeJS Program architecture, NodeJS Web Server, NodeJS Global Objects, NodeJS OS Objects, NodeJS Error Handling, Node JS Event Loop, NodeJS File System, Async and Sync, Connecting with Database, Handling CRUD Operations.

UNIT – V
Introduction to Angular2: Angular2 Architecture (Component-Based Architecture),
Consuming API, State Management, Validation, Routing. Passing data from parent to child and Passing data between siblings.
Angular2 Specific: Directives, Modules, Components, Observables, Binding, Pipes, Dependency Injection.

Textbook:

1. Amos Q. Haviv, "MEAN Web Development", Second Edition, Packt Publications, November 2016
2. Vasan Subramanian, "Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node", 2nd Edition, APress, 2019.

Suggested Reading:

1. Shelly Powers, "Learning Node: Moving to the Server-Side", 2nd Edition, O'REILLY,2016.
2. Simon D. Holmes and Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Second Edition, Manning Publications, 2019
3. Brad Dayley, "Node.js, MongoDB and Angular Web Development", 2nd Edition, Addison- Wesley Professional, 2017.

Online Resources:

1. https://www.mongodbtutorial.org/mongodb-crud/
2. https://reactjs.org/tutorial/tutorial.html
3. https://www.javatpoint.com/expressjs-tutorial
4. https://www.javatpoint.com/nodejs-tutorial
5. https://angular-training-guide.rangle.io/

23CSE105 **SOFTWARE DEFINED NETWORKS**
Elective-I

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
1. To understand the concepts of software defined networks.
2. To learn the interface between networking devices and the software controlling them.
3. To know about SDN in data centers.
4. To explore modern approaches like Openflow, Openstack.

Course Outcomes: Upon completing this course, students will be able to:
1. Differentiate between traditional networks and software defined networks.
2. Understand advanced and emerging networking technologies.
3. Learn how to use SDN controllers to perform complex networking tasks.
4. Demonstrate the skills to do advanced networking research and programming.
5. Apply the knowledge on SDN and security measures to solve real world problems.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	2	-	2	-	2	2	1	-
CO2	1	1	-	-	3	-	1	2	-
CO3	3	1	-	3	-	2	1	-	-
CO4	1	2	-	-	-	-	2	1	-
CO5	1	-	-	2	-	2	-	2	-

UNIT - I

Introduction: Basic packet-Switching terminology - Historical background - The modern Data Center - Traditional switch architecture - Autonomous and dynamic forwarding Tables- Open source and technological shifts.- Evolution of switches and Control plane – Cost- SDN Implications for research and innovation- Data Center Innovation- Data Center needs -The evolution of networking technology - Forerunners of SDN- Sustaining SDN interoperability.

UNIT - II

SDN and OpenFlow Specification: Fundamental characteristics of SDN - SDN operation - SDN Devices- SDN Controller - SDN applications- Alternate SDN methods - OpenFlow Overview - OpenFlow 1.0 and OpenFlow basics- OpenFlow 1.1 additions - OpenFlow 1.2 additions - OpenFlow 1.3 additions - OpenFlow limitations.

UNIT - III

SDN in Data Centers and Other Environment: Data Center definition - Data Center demands- Tunneling technologies for the Data Center- Path technologies in the Data Center - Ethernet fabrics in the Data Center- SDN Use Cases in the Data Center- Open SDN vs Overlays in the Data Center- Real World Data Center implementations- SDN in other environments - Wide Area Networks - Service provider and carrier networks - Campus networks- Hospitality networks- Mobile network

UNIT - IV

SDN Applications and Open-Source Perspectives: Reactive versus proactive applications - Analyzing simple SDN Applications- A simple reactive Java application - Background on controllers - Using the Floodlight controller - Using the Open Daylight controller - Using the Cisco XNC Controller - Switch considerations- Creating network virtualization tunnels - Offloading flows in the Data Center- Access control for the campus- Traffic engineering for service providers.

UNIT-V

SDN Security Challenges: Characteristics of SDN - Security analysis and potential attacks in SDN - Solutions to the security issues in SDN - Network security enhancement using the SDN Framework - Issues and Challenges. SDN applications - Orchestration and network virtualization - Simulation and testing - Tools- Open Stack

Text Books:

1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann Publications, First Edition, 2014.
2. S. Scott-Hayward, S. Natarajan and S. Sezer, "A Survey of Security in Software Defined Networks," in IEEE Communications Surveys & Tutorials, vol. 18, no. 1, pp. 623-654, First quarter 2016.

Suggested Reading:

1. Thomas D. Nadeau and Ken Gray, “SDN - Software Defined Networks” O’Reilly Media , 2013.
2. Siamak Azodolmolky, “Software Defined Networking with OpenFlow”, Packt Publishing, 2013
3. Feamster, Nick, Jennifer Rexford, and Ellen Zegura, "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review , Volume 44, Number 2, 2014,Pages 87-98.
4. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.
5. Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.

Online Resources:

1. https://opennetworking.org/sdn-definition/
2. https://www.javatpoint.com/software-defined-networking-sdn-benefits-and-challenges-of-network-virtualization

23CSE111

ARTIFICIAL INTELLIGENCE
Elective-II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites: UG level Course in Data Structures, Probability and Statistics.

Course Objectives:

1. Understand the different learning techniques of AI systems.
2. Learn different knowledge representation techniques.
3. Developing systems to demonstrate intelligent behavior dealing with uncertainty.

Course Outcomes: After completion of course, students would be:

1. Describe knowledge of the fundamental principles of intelligent systems.
2. Identify various search strategies to solve problems.
3. Compare and contrast knowledge representation schemes.
4. Appraise knowledge in Uncertainty and Probabilistic reasoning approaches.
5. Apply different learning techniques to solve complex problems and understand basic concepts of Natural Language processing.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	3	1	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	2	-	-
CO3	3	2	2	-	-	-	-	-	-
CO4	3	3	2	1	-	1	1	-	-
CO5	3	3	3	2	-	3	2	-	3

UNIT 1:

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of Al, Applications.

Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative - Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look - Ahead Strategy and use of Evaluation Functions, Alpha Beta Pruning.

UNIT 2:

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau, A System in Propositional Logic, Resolution refutation in Propositional Logic, Predicate Logic, Logic Programming.

Knowledge Representation: Introduction, approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT 3:

Expert System and Applications: Introduction, Phases in Building Expert Systems Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and tools. Uncertainty Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster - Shafer Theory.

UNIT 4:

Machine - Learning Paradigms: Introduction, Machine learning System, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees, Deductive Learning, Clustering, Support Vector Machines.

UNIT 5:

Natural Language Processing: Introduction, Sentence Analysis Phases, Grammars and Parsers, Types of Parsers, Semantic Analysis, Universal Networking Knowledge.

Text Books:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, First Edition, 2011.
2. Russell, Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition, 2004.

Suggested Reading:

1. Rich, Knight, Nair , Artificial Intelligence, Tata McGraw Hill, 3rd Edition 2009.
2. The Book of Why: The New Science of Cause and Effect" by Judea Pearl and Dana Mackenzie.2011

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf.
2. http://www.cs.toronto.edu/~fbacchus/csc384/Lecture Hours/Lecture Hours.html.
3. https://nptel.ac.in/courses/106105077/.

23CSE112

DATA MINING AND DATA WAREHOUSING
Elective-II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The objectives of this course are

1. To understand the principles of Data warehousing and Data Mining
2. To be familiar with the Data Warehouse Architecture and its implementation.
3. Learn how to produce a quantitative analysis report/memo with the necessary information to make decisions.
4. Provide understanding of mathematical concepts and algorithms used in data mining.
5. Identifying business applications of data mining
6. Develop and apply critical thinking, problem-solving, and decision-making skills.

Course Outcomes:

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

1. Understand the process, issues and challenges of knowledge discovery
2. Identify and analyze the significance and working of various data preprocessing methods.
3. Learn the architecture of data warehouse and its implementation through multi-dimensional modeling.
4. Understand operational database, warehousing and multidimensional need of data base to meet industrial needs.
5. Explore the concepts of market basket analysis to generate association rules.
6. Analyze and Evaluate the performance of Classification and Clustering algorithms

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	-	-	-	-	2	-	-
CO 2	2	-	1	-	-	-	2	-	-
CO 3	2	-	-	1	1	-	1	-	-
CO 4	2	1	1	1	-	-	1	2	2
CO 5	2	2	-	1	-	-	1	2	2
CO 6	2	2	-	-	-	-	1	2	2

UNIT - I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Issues in Data Mining.
Data Objects and Attribute types, Basic Statistical descriptions of data, Data Visualization, Measuring data similarity and Dissimilarity.
Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT - II

Data Warehouse and Online Analytical Processing: Basic Concepts of Data Warehouse, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Architecture, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction.
Data Cube Computation: Preliminary Concepts, Data Cube Computation Methods

UNIT - III

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods, Frequent Item set Mining Methods, Pattern Evaluation Methods: From Association Analysis to Correlation Analysis.

UNIT - IV

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to improve Classification Accuracy, Classification by Back propagation Prediction, Support Vector Machines, Lazy Learners.

UNIT-V

Cluster Analysis: Basic Concepts and Methods, Partitioning Methods: K-means Technique, Hierarchical Methods: Agglomerative and Divisive, Density Based Methods: DBSCAN technique, Evaluation of Clustering.

Outlier Detection: Outlier Detection Methods, Statistical Approaches, Proximity-Based Approaches, Clustering Based Approaches.

Text Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining – Concepts and Techniques", 3rd edition, Morgan Kaufmann Publishers, ELSEVIER, 2013.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2006.

Suggested Reading:

1. Sam Aanhory & Dennis Murray "Data Warehousing in the Real World", Pearson Edn Asia.
2. K.P.Soman, S.Diwakar, V.Ajay ,"Insight into Data Mining", PHI, 2008.
3. Ralph Kimball Wiley "The Data Warehouse Life cycle Tool kit", student edition
4. William H Inmon, John Wiley & Sons Inc "Building the Data Warehouse", 2005.
5. Margaret H Dunham "Data Mining Introductory and advanced topics", Pearson education.
6. Arun K Pujari "Data Mining Techniques", 2nd edition, Universities Press.

Online Resource:

1. https://dl.ebooksworld.ir/motoman/Cambridge.University.Press.Data.Mining.and.Data.Warehousing.www.EBooksWorld.ir.pdf

23CSE113

HUMAN AND COMPUTER INTERACTION
Elective-II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Computer Graphics

Course Objectives:
The objectives of this course are
1. Learn the foundations of Human Computer Interaction.
2. Be familiar with the design technologies for computer interaction and guidelines for web user interface.
3. Learn the ecosystem and tools of mobile Human Computer interaction.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the structure of models and theories of human computer interaction.
2. Understand the vision of a computer user.
3. Understand the recognition and remembrance limitations of a computer user.
4. Understand the mobile ecosystem and use the corresponding tools for mobile design.
5. Design an interactive web interface on the basis of models studied.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	2	2	-	-	-	-	1
CO 2	3	2	-	-	-	-	-	-	-
CO 3	2	2	-	-	-	-	-	-	1
CO 4	2	1	3	2	1	1	-	-	2
CO 5	2	1	2	3	1	1	2	2	2

UNIT - I
Foundations: The human, the computer, The Interaction, Paradigms
Introduction: Our perception is biased; our vision is optimized to see structure.

UNIT - II
We Seek and Use Visual Structure, Our Color Vision is Limited, Our Peripheral Vision is Poor, Reading is Unnatural, Our Attention is Limited; Our Memory is Imperfect, Limits on Attention Shape Our Thought and Action.

UNIT - III
Recognition is Easy, Recall is Hard, Problem Solving and Calculation are Hard, Many Factors Affect Learning, Human Decision Making is Rarely Rational.

UNIT - IV
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Tools.

UNIT-V
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Textbooks:

1. "Designing with the Mind in Mind – Simple Guide to Understanding", 2nd edition, Jeff Johnson, Elsevier Inc., 2010.
2. "Human Computer Interaction", 3rd edition, Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, Pearson Education Limited, 2004.
3. Brian Fling, “Mobile Design and Development”, First Edition , O Reilly Media Inc., 2009.
4. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O Reilly, 2009.

Suggested Readings:

1. "Designing the User Interface", 5th Edition, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Pearson Education Limited, 2013.
2. "Mind Design II, 2nd Edition", Revised and enlarged edition, John Haugeland, The MIT Press, 1997.

Online Resources:

1. https://nptel.ac.in/courses/106103115/
2. https://www.interaction-design.org/courses/hci-foundations-of-ux-design?ad-set=human-computer-+interactioncourse&gclid=EAIaIQobChMIkJuW09jM4QIVgTgrCh0PuwtXEAAYASAAEgLPhPD_Bw

23CSE114

SOFTWARE ARCHITECTURES
Elective-II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Software Engineering, Design Patterns.

Course Objectives: The objectives of this course are

1. To understand the importance of Software Architecture and design process.
2. To understand Architectural styles, Patterns, and Quality Attributes
3. To gain knowledge in software architecture evaluation using real-world scenarios.

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

1. Understand the fundamental concepts and principles of software architecture.
2. Identify and apply different architectural styles and design patterns.
3. Evaluate architectural trade-offs and make informed design decisions.
4. Apply software architecture principles to design and evaluate software systems.
5. Develop skills in architectural modeling and analysis.
6. Apply software architecture best practices in real-world scenarios.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	1	1	-	1	-	1	1	-
CO 2	2	3	2	1	2	1	2	1	2
CO 3	2	1	-	1	1	1	-	-	1
CO 4	3	2	-	-	-	-	1	1	1
CO 5	2	1	1	1	-	-	1	-	2
CO 6	3	1	2	-	1	1	2	-	2

UNIT – I

Introduction to Software Architecture: Definition and importance of software architecture, Roles and responsibilities of a software architect, Architectural styles and patterns. Architectural Design: Architectural design process, Requirements analysis and system decomposition, Architectural decision-making, and trade-offs, Architecture documentation and communication, Architecture evaluation and validation.

UNIT – II

Architectural Styles and Patterns: Layered architecture, Client-server architecture, Service-oriented architecture (SOA), Model-View-Controller (MVC) pattern, Publish-Subscribe pattern, Event-Driven architecture, Repository pattern, Dependency Injection pattern, Quality Attributes, Trade-offs

UNIT – III

Architectural Quality Attributes: Performance, scalability, and reliability, Availability and fault tolerance, Maintainability and modifiability, Security and privacy, Usability, and user experience. **Software Architecture Documentation**: Architectural views and their documentation, UML (Unified Modelling Language) for architectural representation, and Architecture description languages (ADLs).

UNIT – IV

Software Architecture Evaluation: Static and dynamic analysis techniques, Formal methods for architecture verification, Architecture trade-off analysis.

UNIT – V

Case Studies: Analysis of existing software architectures Case studies of architectural design in different domains (e.g., e-commerce, finance, healthcare)

Textbook:

1. "Software Architecture in Practice" by Len Bass, Paul Clements, and Rick Kazman
2. "Evaluating Software Architectures: Methods and Case Studies" by Paul Clements et al.

Online Resources:

1. Software Architecture | Coursera
2. Software architecture | Udemy

23CSE115

PARALLEL AND DISTRIBUTED SYSTEMS
Elective-II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites:
Basic knowledge of parallel and distributed concepts , Basic programming .

Course Objectives:
The objectives of this course are
1. To learn core ideas behind parallel and distributed computing.
2. To explore the methodologies adopted for parallel and distributed environments.
3. To understand the networking aspects of parallel and distributed computing.
4. To provide an overview of the computational aspects of parallel and distributed computing.
5. To learn parallel and distributed computing models.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Explore the methodologies adopted for parallel and distributed environments.
2. Analyze the networking aspects of Distributed and Parallel Computing.
3. Explore the different performance issues and tasks in parallel and distributed computing.
4. Tools usage for parallel and distributed computing.
5. Understanding high performance computing techniques.
6. Experience in the design, development, and performance analysis of parallel and distributed applications

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	-	2	-	-
CO 3	2	-	1	-	-	-	1	-	-
CO 4	2	1	-	-	-	-	1	-	-
CO 5	2	2	-	-	-	-	1	-	-
CO 6	2	2	1	1	-	-	1	-	-

UNIT - I
Introduction to High Performance Computing Overview of high performance computing and Java Framework, Concurrent techniques, The benefits of parallel programming, The benefits of distributed programming, The basic layers of Concurrent techniques, Categories of computers...

UNIT - II
Introduction to Parallel and Distributed Computing, Flynn's Taxonomy of Parallel Architectures: Parallel/Vector Computers, Shared Memory Multiprocessors (UMA, NUMA, COMA), Distributed Memory Multiprocessors, Multi vector and SIMD computers, Data Parallel Pipelined and Systolic Architectures, Instruction set Architectures (CISC, RISC, VLIW, super pipelined, vector processors), Performance Evaluation of Computer Systems, PRAM Model of Parallel Computation, PRAM Algorithms: Parallel Reduction, List Ranking, Preorder tree traversal.

UNIT - III
Interconnection Topologies and Routing for Parallel Processing Systems: Categorization of Topologies, On-Chip Interconnection Topologies, Supercomputer Interconnection Topologies: Blue Waters, Blue Gene/Q, A case Study of HPC, Topology detection, Comparison of Topologies: The Moore Bound, Routing in Static Networks: Topology independent Routing (Point-to-Point routing, Broadcasting, Gossiping), Topology dependent routing.

UNIT - IV
Shared Memory Programming with Pthreads (Critical Sections, Busy Waiting, Mutexes, Barriers And Condition Variables, Read-Write Locks), Shared Memory Programming with OpenMP: Cover OpenMP basics, Distributed Memory Parallel Programming: Cover MPI programming basics with simple programs and most useful directives, Collective Communication, Parallel Sorting Algorithm, Performance Evaluation of MPI programs.

UNIT V

Advnced Topics: Introduction to OpenCL, Parallel programming with OpenACC, Introduction to Data Parrallelism and CUDA C, Distribuited Object Computing Tools: Basic Models (RMI, CORBA, DCOM), Trends and Visions (Cloud and Grid Computing, P2P computing, Autonomic Computing).

Text Books:

1. Advanced computer architectures, Dezso Sima
2. Advanced computer architecture, Kai Hwang & Naresh Jotwani
3. Parallel Programming for Multicore and Cluster systems, Thomas Rauber Gudula Runger
4. An introduction to parallel programming, Peter S.Pacheco
5. Tools and Environment for Parallel and Distributed Computing, Salim Hariri Manish Parashar
6. Pogramming Massively Parallel Processors, David Kirk

REFERENCES:

1. Interconnection Topologies and Routing for Parallel Processing Systems : Gabriele Kotsis, Technical Report Series, ACPC/TR 92-19,1992
2. Topology and Routing Aware Mapping on Parallel Processors, Thesis, Dept. of Mathematics & computer sciences , Sri satya sai institute of high learning

Online Resources:

1. https://engineering.ucdenver.edu/CSCI-research/parallel-and-distributed-systems
2. http://wla.berkeley.edu/~cs61a/fa11/lectures/communication.html

23CS C103

RESEARCH METHODOLOGIES IN COMPUTER SCIENCE AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

1. To understand the research process
2. To solve unfamiliar problems using scientific procedures
3. To pursue ethical research
4. To use appropriate tools for documentation and analysis of data

Course Outcomes:

On completion of this course, the student will be able to implement

1. Understand research problem formulation
2. Design experiments
3. Analyze research related information
4. Write papers and thesis, Follow research ethics
5. Use tools for analysis and thesis writing

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	3	-	1	-	-	-	-	-
CO 2	3	2	1	2	-	-	-	-	-
CO 3	3	2	1	1	-	-	1	-	1
CO 4	3	3	1	2	-	-	-	-	-
CO 5	3	2	1	2	2	-	1	-	2

UNIT – I

Research Process: Meaning of Research, Objectives and Motivation of Research, Technological Innovation, Types of Research, Research Vs Scientific method, Research Methodology vs Research Methods, Research process. Research Problem Formulation: Problem solving in Engineering, Identification of Research Topic, Problem Definition, Literature Survey, Literature Review.

Research Design: Research Design: What it is? Why we need Research Design? Terminology and Basic Concepts, Different Research Designs, Experimental Designs, Important Experimental Designs, Design of Experimental Setup, Use of Standards and Codes.

UNIT – II

Mathematical Modeling: Models in General, Mathematical Model, Model Classification, Modelling of Engineering Systems. Probability and Distributions: Importance of Statistics to Researchers, Probability Concepts, Probability Distributions, Popular Probability Distributions, Sampling Distributions. Sample Design And Sampling: Sample design, Types of sample designs, The Standard Error, Sample Size for Experiments, Prior Determination Approach, **Use of Automatic Stopping Rule Hypothesis Testing and ANOVA**: Formulation of Hypothesis, Testing of Hypothesis, Analysis of Variance.

UNIT – III

Design of Experiments and Regression Analysis: Design of Experiments, Planning of Experiments, Multivariate Analysis, Simple Regression and Correlation, Multiple Regression and Correlation Analysis and Interpretation of Data: Introduction, Data Checking, Data Analysis, Interpretation of Results, Guidelines in Interpretations. Accuracy, Precision and Error Analysis: Introduction, Repeatability and Reproducibility, Error Definition and Classification, Analysis of Errors, Statistical Analysis of Errors, Identification of Limitations

UNIT – IV

Writing of Papers and Synopsis: Introduction, Audience Analysis,, Preparing Papers for Journals, Preparation of Synopsis of Research Work Thesis Writing Mechanics: Introduction, Audience for Thesis Report, Steps in Writing the report, Mechanics of Writing, Presentation of graphs, figures and tables.

Structure of Thesis Report: Suggested Framework of the Report, Preliminary Pages, Main Body of Thesis, Summary, Appendices, References, Glossary.

UNIT –V

Ethics in Research: Importance of Ethics in Research, Integrity in Research, Scientific Misconduct and Consequences. Spreadsheet tool: Introduction, Quantitative Data Analysis Tools, Entering and preparing your data, Using statistical functions, Loading and using Data Analysis Tool Pack [Tools: Microsoft Excel / Open office]Thesis writing & scientific editing tool[Tool: Latex]: Introduction, Document Structure, Typesetting Text, Tables, Figures, Equations, Inserting References.

Text Books

1. R.Ganesan; Research Methodology for Engineers; MJP Publishers; Chennai, 2011
2. Paul R Cohen. Empirical Methods in AI. PHI, New Delhi, 2004
3. C.R.Kothari, Research Methodology, Methods & Technique; New age International Publishers, 2004

Suggested Readings

1. Kumar, Ranjit. Research Methodology-A Step-by-Step Guide for Beginners,(2nd.ed), Singapore, Pearson Education, 2005
2. LaTEX for Beginners, Workbook, Edition 5, March 2014.

23CSC104

ADVANCED ALGORITHMS LAB
Laboratory 1

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-Requisites: UG level course in Design and analysis of algorithm Lab using any programming Language.

Course Objectives:

1. Built up strong skills to implement algorithms for various problems.
2. Familiarize with efficient utilization of programming language constructs while implementing algorithms along with their complexities.
3. Able to apply strategies to solve realtime problems.

Course Outcomes:

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

1. Identify and Apply data structures to various problems
2. Describe and analyze various advanced Algorithms.
3. Implement various algorithmic design techniques.
4. Analyze the time complexities of various algorithms
5. Apply different paradigm on same problem and identifies the computation efficiency of the algorithm.
6. Design and identify the suitable algorithmic paradigm to solve real world problems

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	1	-	-	-	-	-	-
CO 2	3	3	1	-	-	-	-	-	-
CO 3	3	3	1	-	-	-	-	-	-
CO 4	3	3	1	-	-	-	-	-	-
CO 5	3	3	1	1	-	-	1	1	-
CO 6	3	3	1	1	1	-	1	1	-

List of Experiments:

1. Implementation of Sorting- heap sort, quick sort, topological sort using queue.
2. Implementation of BFS using queue and DFS using stack and in both implementations use linked list to store adjacency list of each node.
3. Implementation of strongly connected components.
4. Implementation of Minimum Spanning Trees.
5. Implementation of Maximum Sub-Array Problem, Stassen's Matrix Multiplication
6. Implementation of Shortest Path Algorithms.
7. Implementation of Longest Common Subsequence.
8. Implementation of Matrix Chain Multiplication, Simplex Algorithm, Floyd-Warshall algorithm.

Textbooks:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press., 2009.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2nd Edition, Pearson, 2004.
3. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication 2016.
4. Satish Kumar, –"Neural Networks -A classroom approach"; Second Edition, TMH, 2017.

Online Resources :

1. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms. html
2. https://www.geeksforgeeks.org/top-algorithms-and-data-structures-for-competitive-programming/
3. http://www. nptelvideos . com/java/java _ video _ Lecture Hours_tutorials.php
4. https://nptel.ac.in/courses/106104019/

23CSE106

MACHINE LEARNING LAB

(Laboratory-2 Based on Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre Requisites: UG level Course in Probability and Statistics, Proficiency inprogramming basics.

Course Objectives:

The objectives of this course are

1. To implement the machine learning algorithms
2. Implement the machine learning concepts in any suitable language of choice.
3. To explore Deep learning technique and various feature extraction strategies.

Course outcomes:

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

1. Apply mathematical foundations, algorithmic principles, and computer science theory to the modeling of computer- based systems.
2. Identify and utilize modern tools that are useful for data analysis.
3. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Implement unsupervised learning algorithms.
5. Implement and evaluate various Machine Learning approaches.
6. Design and develop solutions to real world problems using ML techniques.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	3	-	1	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-
CO3	3	2	1	1	-	-	1	-	1
CO4	3	3	1	2	-	-	-	-	-
CO5	3	2	1	2	2	-	1	-	2
CO6	3	3	1	2	-	-	-	-	-

Description (If any):

1. The programs can be implemented in either JAVA or Python.
2. For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.
3. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

Lab Experiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Textbooks:

1. Tom M. Mitchell, "Machine Learning", India Edition, McGraw Hill Education 2013.
2. Herbert Schildt& Dale Skrien, "Java Fundamentals-A Comprehensive Introduction", 2013 Edition, Tata McGraw-Hill.

Suggested Readings:

1. Herbert Schildt, "The Complete Reference Java", 7 Edition, Tata McGraw-Hill 2007.
2. ReemaThareja "Python Programming", Oxford Press, 2017.
3. Mike McGrath "Python in easy steps: Makes Programming Fun", Kindle Edition, 2017.

Online Resources:

1. http://www.cs.cmu.edu/~tom/mlbook-chapter-slides.html
2. http://www.cs.cmu.edu/afs/cs.cmu.edu/user/mitchell/ftp/mlbook.html

23CSE107

DATA PREPARATION AND ANALYSIS LAB

(Laboratory-2 Based on Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives:

The objectives of this course are

1. Identify data gathering and preparation techniques for industrial and scientific applications.
2. Apply exploratory data analysis techniques to develop meaningful data visualizations.
3. Analyze various statistical significance based testing mechanisms and apply them to deal with real-world problems.

Course Outcomes:

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

1. Differentiate between numerical and categorical attributes and apply various pre-processing techniques to clean any chosen dataset.
2. Apply discretization and clustering techniques on preprocessed data.
3. Apply Association Rule mining technique to explore relationships among various attributes.
4. Apply exploratory data analysis techniques to develop meaningful data visualizations.
5. Apply various file-processing operations to deal with real-world datasets.
6. Create applications to deal with interactive datasets suitable to explore the significance of variables.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	3	3	2	1	1	-	-
CO 2	3	3	2	2	1	1	-	-	-
CO 3	3	3	3	2	1	1	-	-	-
CO 4	3	3	3	2	1	1	-	-	-
CO 5	3	3	3	2	1	1	1	-	-
CO 6	3	3	3	2	2	1	1	-	-

List of programs: Implement the following programs

1. Load any one dataset and perform following activities
2. List all the categorical (or nominal) attributes and the real-valued attributes separately.
3. What attributes do you think might be crucial in building the any data set?
4. Apply the cleaning process for the dataset (Replace Missing values).
5. Do you really need to input so many attributes to get good results? May be only a few would do. For example, you could try just having some combination of attributes, the class attribute (naturally)). Try out some combinations. (You had removed two attributes from the data set. Remember to reload the ARRF data file to get all the attributes initially before you start selecting the ones you want.)
6. Implement the discretization on any data set.
7. Demonstrate performing clustering on data sets.
8. Perform data pre-processing tasks and demonstrate performing association rule mining on data sets.
9. Load the MLB dataset and write a program to: Explore how relationships can be instantly and powerfully conveyed through the spatial arrangement of data, Visual elements such as icons and lines, and most significantly, the use of animation.
    a. Loading Text Data.
    b. Files Too Large for loadStrings( )
    c. Reading Files Progressively.
    d. Reading Files Asynchronously with a Thread.
    e. Parsing Large Files As They Are Acquired.
    f. Load Milk, Tea, and Coffee dataset and perform the following activities
    g. Write a program to Acquiring a table of data from a text file.
    h. Write a program to perform parsing the contents of the file into a usable data structure.
    i. Write a program to calculate the boundaries of the data to facilitate representation.
    j. Write a program to find a suitable representation and considering alternatives.
    k. Write a program to refine the representation with consideration for placement, type, line weight, and color.
10. Design an application by providing a means of interacting with the data so that the variables can be compared against one another or against the average of the whole data set.

Textbooks:

1. Glenn J. Myatt, "Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining", John Wiley & Sons, Inc
2. , 2007.
3. Ben Fry, "Visualizing Data: Exploring and Explaining Data with the Processing Environment", O'Reilly Media, Inc, 2007.

Suggested Readings:

1. Robert Wysocki, "Effective Project Management: " Traditional, Agile, Extreme, Sixth edition, Wiley India, rp2011.
2. Watts S. Humphrey "An Introduction to the Team Software Process", Pearson Education, 2000.
3. James R. Persse, Process Improvement essentials, O'Reilly, 2006.
4. Bob Hughes & Mike Cotterell, "Software Project Management", fourth Edition, TMH, 2006.
5. Andrew Stellman& Jennifer Greene, Applied Software Project Management, O'Reilly, 2006.

Online Resources:

1. https://www.safaribooksonline.com/library/view/visualizing- data/ 9780596514556/ch08.html.
2. https://www.scribd.com/document/54993779/Making-Sense-of-Data-a-Practical-Guide-to-Exploratory-Data-Analysis-and-Data- Mining.

23CSE108

COMPUTER GRAPHICS LAB

(Laboratory-2 Based on Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives:

The objectives of this course are

1. Understand the principles of computer graphics.
2. Apply both 2D and 3D graphics. and raster scan graphics including line and circle drawing, polygon filling,
3. Study clipping, hidden-line and hidden surface algorithms including ray tracing and, of course, rendering

Course Outcomes:

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

1. Understand modern software that is used in current scenario of computer graphics.
2. Demonstrate the understanding of contemporary graphics hardware.
3. Create and formulate interactive graphics applications in programming language
4. Apply program functions to implement graphic primitives API like OpenGL.
5. Model Demonstrate geometrical transformations.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	-	-	2	-	3	3	2
CO 2	3	3	-	-	-	-	3	2	2
CO 3	3	3	3	-	-	-	3	3	2
CO 4	3	3	3	-	-	-	3	2	2
CO 5	3	3	3	3	-	-	3	2	2

Design, develop, and implement the following programs using OpenGL API

1. Implement DDA and Bresenham‟s line drawing algorithms for all types of slope.
2. Implementation of mid-point circle and ellipse generating Algorithm.
3. To translate an object with translation parameters in X and Y directions.
4. To scale an object with scaling factors along X and Y directions.
5. To rotate an object with a certain angle about origin. Perform the rotation of an object with certain angle about an arbitrary point.
6. To perform composite transformations of an object.
7. To Clip a lines using Cohen-Sutherland algorithm.
8. To draw a simple shaded scene consisting of a tea pot on a table. Define suitably the Position and properties of the light source along with the properties of the surfaces of the solid object used in the scene.
9. Develop a menu driven program to animate a flag using Bezier Curve algorithm.
10. Develop a menu driven program to fill the polygon using scan line algorithm.

PART B MINI PROJECT

Student should develop mini project on the topics mentioned below or similar applications using Open GL API. Consider all types of attributes like color, thickness, styles, font, background, speed etc., while doing mini project.

Textbook:

1. Interactive Computer Graphics A Top-Down Approach with OpenGL, Edward Angel, Pearson, 5 th Edition, 2009.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs97/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee23/preview

23CSE109

FULL STACK DEVELOPMENT LAB

(Laboratory-2 Based on Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives: The objectives of this course are

1. To acquire knowledge on MongoDB, ReactJS, Express Node.js and Angular2 to develop web applications.
2. Ability to develop dynamic web content using web frameworks.
3. To understand the design and development process of a complete web application

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

1. Prepare database connections with application servers.
2. Design user interfaces using ReactJS.
3. Construct strong expertise on Express framework to develop responsive web applications.
4. Create server side applications using Node.js
5. Develop SPA using Angular 2.
6. Invent next culture-shifting web applications.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	1	1				-	-	1
CO 2	3	3	3	-	-	-	2	-	1
CO 3	3	3	3	-	-	-	2	-	1
CO 4	3	3	3	-	-	-	2	-	1
CO 5	3	2	3	-	-	-	2	-	1
CO 6	3	3	3	-	-	-	3	-	1

List of Programs:

1. Installation, configuration and connection establishment of MongoDB.
2. CRUD operations on MongoDB
3. Building & Deploying React App
4. Demonstration of component intercommunication using ReactJS
5. Create Express application,
6. Demonstration of authentication and authorization using Express.
7. Data access using Node.js
8. Create a form to edit the data using Angular2
9. A case study on a single platform for all financial data for NSE India.

Textbook:

1. Amos Q. Haviv, MEAN Web Development, Second Edition, Packt Publications, November 2016
2. Vasan Subramanian, “Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node”, 2nd Edition, APress.

Suggested Reading:

1. Shelly Powers, “Learning Node: Moving to the Server-Side”, 2nd Edition, O’REILLY, 2016.
2. Simon D. Holmes and Clive Harber, “Getting MEAN with Mongo, Express, Angular, and Node”, Second Edition, Manning Publications, 2019.
3. Brad Dayley, “Node.js, MongoDB and Angular Web Development”, 2nd Edition, Addison-Wesley Professional, 2017.

Online Resources:

1. https://www.mongodbtutorial.org/mongodb-crud/
2. https://reactjs.org/tutorial/tutorial.html
3. https://www.javatpoint.com/expressjs-tutorial
4. https://www.javatpoint.com/nodejs-tutorial
5. https://angular-training-guide.rangle.io/

23CSE110

SOFTWARE DEFINED NETWORKS LAB

(Laboratory-2 Based on Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-Requisites: Computer Networks, Operating Systems, Programming and Scripting, Network security

Course Objectives:

1. To equip students with the necessary skills, knowledge, and practical experience to understand, design, implement, and manage software-defined networks.
2. Students will gain a deep understanding of SDN principles, protocols, and applications, preparing them for real-world networking challenges in modern software-defined environments.
3. To provide a hands-on learning environment where students or researchers can gain practical experience with SDN concepts, technologies, and protocols.

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

1. Proficient in installing, configuring and managing SDN controllers such as OpenDaylight, Ryu, or ONOS.
2. Design and configure SDN network topologies using tools like Mininet or Open vSwitch
3. Define flow rules, match packets based on different criteria, and program switches to forward traffic according to desired policies
4. Understand how to dynamically route traffic, prioritize specific types of traffic, and enforce QoS policies using SDN controllers.
5. Understand how SDN can be applied to solve specific networking challenges.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	2	-	2	-	2	2	1	-
CO2	1	1	-	-	3	-	1	2	-
CO3	3	1	-	3	-	2	1	-	-
CO4	1	2	-	-	-	-	2	1	-
CO5	1	-	-	2	-	2	-	2	-

List of Experiments:

1. Install Mininet and OpenFlow controller software on Ubuntu Linux.
2. Launch Mininet using a virtual machine with the virtual switches and hosts.
3. Create the topology of the virtual network using commands in Mininet.
4. Start the OpenFlow controller software.
5. Configure the OpenFlow controller to manage the virtual network created in step 3.
6. Test connectivity between hosts in the virtual network.
7. Configure network services such as Quality of Service (QoS), security policies, and firewall rules using OpenFlow rules.
8. Analyze network traffic flow using OpenFlow statistics.
9. Modify the network topology and observe how the changes impact the network performance and traffic flow.
10. Deactivate the OpenFlow controller and observe how the network behaves without centralized control.

Textbooks:

1. Software Defined Networking: Design and Deployment Hardcover – 3 December 2014
2. Mastering Mininet" by Benjamin Lerner and David Mahler.,2015.

Suggested Readings:

1. "OpenFlow: Switch Specification" by the Open Networking Foundation.(https://opennetworking.org/wp-content/uploads/2014/10/openflow-switch-v1.5.1.pdf)-2014
2. OpenFlow Cookbook" by Brent Salisbury, Bob Lantz, and Rajdeep Dua.-2015soft c

Online Resources:

1. https://mininet.org/
2. https://github.com/mininet/openflow-tutorial.
3. https://ryu.readthedocs.io/
4. http://www.projectfloodlight.org/floodlight/
5. https://www.opennetworking.org/

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING

(MTech Audit Course I/II Sem- Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

Course Objectives:

This course aims to:

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.

Understand to implement the intricacies of writing and publishing a research paper.

Course Outcomes:

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

1. Improve work performance and efficiency Illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.

Develop an original research paper while acquiring the knowledge of how and where to publish their papers

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	2	3	2
CO 2	1	1	1		1	2
CO 3	2	2	2	1	1	1
CO 4	2	2	1	1	2	2
CO 5	3	3	1	2	3	2

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a Research Paper, Writing to Draft a Format, Develop Content, Adapting, Reviewing, Paraphrasing & Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

Text Books:

1. Kothari, C. R. and Gaurav, Garg, "Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

Suggested Reading:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for Writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23CEA101

DISASTER MITIGATION AND MANAGEMENT
(M. Tech Audit Course I/II Sem - Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Course Objectives:

The objectives of this course are

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters.
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters.
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions.

Course Outcomes:

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels.
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management.
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same.
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4
CO 1	2	3	2	1
CO 2	3	3	2	2
CO 3	2	3	3	2
CO 4	3	3	2	3
CO 5	3	2	2	3

UNIT - I

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT - II

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT - III

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT - IV

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological,economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programs in India and the activities of National Disaster Management Authority.

Textbooks:

1. Pradeep Sahni," Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh," Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Readings:

1. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II", Latest 2016.
2. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.
3. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs, 2003.

Online Resources

1. http://www. indiaenvironmentportal .org . in/files/file/ disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

23EEA101

SANSKRIT FOR TECHNICAL KNOWLEDGE

(M.Tech Audit Course I/II Sem - Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Course Objectives:

The objectives of this course are

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects.
3. To explore the huge knowledge from ancient Indian literature.

Course Outcomes:

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

1. Develop passion towards Sanskrit language.
2. Decipher the latent engineering principles from Sanskrit literature.
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress.
5. Explore the avenue for research in engineering with aid of Sanskrit.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4
CO 1	-	-	-	1
CO 2	1	1	1	1
CO 3	-	1	1	1
CO 4	1	-	1	1
CO 5	1	1	1	1

UNIT - I

Introduction to Sanskrit language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT - II

Role of Sanskrit in Basic sciences: Brahmagupthas lemmas (second degreeindeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).The measurement system-time-mass- length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT - III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingalachandasutram (origination of digital logic system)

UNIT - IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures Chemical laboratory location and layout-equipment-distillation vessel-kosthiyanthram-

Textbooks:

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, MotilalBanarsidass Publishers, ISBN-13: 978-8120801783,2015.
3. Kapail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.

Suggested Readings:

1. Pride of India, SamskritaBharati Publisher, ISBN: 81-87276 27-4, 2007
2. Shri RamaVerma, Vedas the source of ultimate science, Nag publishers, ISBN:81-7081 618-1,2005.

23ECA101

VALUE EDUCATION

(MTech Audit Course I/II Sem - Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Course Objectives: The objectives of this course are

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals.
3. Cultivate individual and National character.

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

1. Gain necessary Knowledge for self-development.
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life.
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4
CO 1	-	-	-	1
CO 2	-	-	-	1
CO 3	-	-	1	1
CO 4	-	-	-	1
CO 5	-	-	-	1

UNIT - I

Human Values, Ethics and Morals: Concept of Values, Indian concept ofhumanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT - II

Value Cultivation, and Self-management: Need and Importance of cultivationof values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT - III

Spiritual outlook and social values: Personality and Behavior, Scientific attitudeand Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, Avoiding fault findingin others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT - IV

Values in Holy Books: Self-management and Good health; and internal & externalCleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Characterand Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

Text Books:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

23EGA102

CONSTITUTION OF INDIA

(M.E/M. Tech - Common to all Branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Prerequisite: Knowledge on basics of the Constitution and the Government.

Course Objectives:

This course aims to:

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes:

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	-	-	1	1
CO 2	1	1	-	-	1	1
CO 3	1	2	-	-	1	1
CO 4	1	2	-	-	1	1
CO 5	1	2	-	-	1	1

UNIT - I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working).
Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT - II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT - III

Organs of Governance - Parliament : Composition, Qualifications, Powers and Functions
Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT - IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: ZillaPanchayat, Elected Officials and their roles, CEO ZillaPanchayat: positions and role.

Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

Text Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Busi, S. N., Dr. B. R. Ambedkar, Framing of Indian Constitution'', 1st Edition, Ava Publishers, New Delhi, 2015.
3. Jain, M. P., "Indian Constitution Law", 7th Edition, Lexis Nexis, New Delhi, 2014.
4. Basu, D.D. "Introduction to the Constitution of India", Lexis Nexis, New Delhi., 2015.

Suggested Reading:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

23ADA101

PEDAGOGY STUDIES
(MTech Audit Course I/II Sem - Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PSO1	PSO2
CO1	1	1	1	1	1
CO2	1	1	1	1	1
CO3	2	2	2	2	2
CO4	1	1	1	1	1
CO5	2	2	2	2	2

UNIT - I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT - II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT - III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT - IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

23EGA103

STRESS MANAGEMENT BY YOGA
(M.E/M. Tech - Common to all Branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Prerequisite: Knowledge on Yoga Practices.

Course Objectives:

This course aims to:

1. Create awareness about different types of stress and the role of yoga in the management of stress.
2. Promote positive health and overall well-being (Physical, mental, emotional, social and spiritual).
3. Prevent stress related health problems by yoga practice.

Course Outcomes:

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	-	1	1
CO 2	1	1	-	-	1	1
CO 3	1	1	-	-	1	1
CO 4	1	1	-	-	1	1
CO 5	1	1	-	-	1	1

UNIT - I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali).

UNIT - II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT - III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT - IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT – V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. Janardhan, Swami, "Yogic Asanas for Group Training - Part-I": Yogabhyasi Mandal, Nagpur.
2. Vivikananda, Swami**,** "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and R. Nagaratna, “Yoga Perspective in Stress Management”, Swami Vivekananda Yoga Prakashan, Bangalore.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23 EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS
(MTech. Audit Course I/II Sem - Common to all branches)

Instruction	2 hrs per week
Duration of End examination	2 hrs
Semester end examinations	50
CIE	-
Credits	Non Credit

Prerequisite: Awareness on Personality Development. Course Objectives:
This course aims to:

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	-	1	1
CO 2	1	1	-	-	1	1
CO 3	1	1	-	-	1	1
CO 4	1	1	-	-	1	1
CO 5	1	1	-	-	1	1

UNIT - I
Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT – II
Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III
Introduction to Bhagavadgeetha for Personality Development – Shrimad Bhagawad Geeta: Chapter 2–Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 –Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV
Statements of basic knowledge – Shrimad Bhagawad Geeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from ShrimadBhagawatGeeta.

UNIT - V
Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. Gopinath, P., "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi, 2018.
2. Swarupananda, Swami, "Srimad Bhagavad Geeta", Advaita Ashram (Publication Dept), Kolkata, 2017.

Online Resources:

1. http://nptel.ac.in/downloads/109104115/

23CSC105

ADVANCED DATABASES

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites: DBMS, Relational Calculus.

Course Objectives:

1. To introduce various advanced data models that are non-relational, and extensions to relational model
2. To introduce implementation details of Query processing Module in RDBMS
3. To introduce Database-System Architectures, parallel and distributed storage systems
4. To study query processing and transaction processing in parallel and distributed databases
5. To introduce the concepts of performance tuning , benchmarking and advanced indexing techniques

Course Outcomes: After Completion of the course Students will be able to:

1. Explain the need for complex types in databases and their implementation –spatial, object oriented, text and semi-structured databases
2. Do back-of-envelope estimates of I/O operations for different algorithms in query evaluation engine
3. Compare different types of Database-System Architectures , replication and fragmentation in distributed and parallel storage systems
4. Describe different concurrency and commit protocols in distributed databases
5. Tune data bases for performance, understand Spatial indexing techniques and bloom filters

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	-	-	-	-			-
CO 2	2	-	-	-	-	-	2	3	-
CO 3	2	1	1	-	-	-	3	2	-
CO 4	2	1	1	-	-	-	2	2	-
CO 5	2	1	1	-	-	-	2	2	-

UNIT– I:

Complex Data types:

Semi-structured Data -Overview of Semi-structured Data Models, JSON, XML, RDF and Knowledge Graphs.

Object Orientation - Object-Relational Database Systems, Object-Relational Mapping.

Textual Data -Keyword Queries, Relevance Ranking, Measuring Retrieval Effectiveness, Keyword Querying on Structured Data and Knowledge Graphs.

Spatial Data- Representation of Geometric Information, Design Databases, Geographic Data, Spatial Queries

UNIT– II:

Query Processing: Overview, Measures of Query Cost, Selection Operation, Sorting, join Operation, Other Operations, Evaluation of Expressions, ++Query processing in the memory

Query Optimization: Overview, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans, Materialized Views, Advanced topics in Query optimization

UNIT– III:

Database-System Architectures: Centralized Database Systems, Server System Architectures, Parallel Systems, Distributed Systems, Transaction Processing in Parallel and Distributed Systems, Cloud-Based Services

Parallel and Distributed Storage : Data Partitioning, Dealing with Skew in Partitioning, Replication, Parallel Indexing, Parallel Key-Value Stores

UNIT– IV:

Parallel and Distributed Query Processing: Parallel Sort, Parallel Join, Other Operations, Parallel Evaluation of Query Plans, Query Processing on Shared-Memory Architectures, Query Optimization for Parallel Execution, Parallel Processing of Streaming Data, Distributed Query Processing

Parallel and Distributed Transaction Processing: Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Replication, Extended Concurrency Control Protocols, Replication with Weak Degrees of Consistency, Coordinator Selection, Consensus in Distributed Systems.

UNIT– V:

Advanced Application Development: Performance Tuning, Performance Benchmarks, Other Issues in Application Development, Standardization, Distributed Directory Systems.

Advanced Indexing Techniques: Bloom Filter, Indexing of Spatial Data, B-Tree Variants, Lock Structured storage

Text Books

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGraw Hill International Edition, 7th Edition, 2019.
2. Data base Internals Alex Petrov O'RElley, 1st Edition
3. ElmasriNavathe, Somayajulu, Gupta, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2006.

Suggested Reading:

1. CJ Date, A Kannan, S Swamynathan, An Introduction to Database Systems, Pearson Education, 8thEdition, 2006
2. Raghu Ramakrishnan, and Johannes Gehrke, Database Management Systems, McGraw-Hill International Edition, 3rd Edition, 2002

23CSC106

SOFT COMPUTING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: UG level course in Basic knowledge of mathematics.

Course Objectives: The objectives of this course are

1. To learn various types of soft computing techniques and their applications.
2. To acquire the knowledge of neural network architectures, learning methods and algorithms.
3. To understand Fuzzy logic, Genetic algorithms and their applications.

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

1. 1. Illustrates various soft computing techniques.
2. Analyze and design various learning models.
3. Apply the Neural Network Architecture for various Real time applications.
4. Apply approximate reasoning using fuzzy logic.
5. Analyze and design Genetic algorithms in different applications.
6. Apply soft computing techniques to solve different applications.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	-	-	-	-	-	-	-
CO 2	2	2	1	2	1	-	2	3	-
CO 3	3	1	-	1	1	-	3	2	-
CO 4	1	-	-	-	-	-	2	2	-
CO 5	2	1	1	1	1	-	2	2	-
CO 6	2	2	-	1	1	-	3	-	-

UNIT – I

Introduction: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence, Hard vs Soft computing.

UNIT – II:

Artificial Neural Networks: Fundamental concepts, Evolution of neural networks, Basic models of artificial neural network, Important terminologies of ANNs. McCulloch-Pitts neuron, linear separability, Hebb network.

Supervised Learning Neural Networks: Perceptron networks, Adaptive linear neuron (Adaline), Multiple Adaptive linear neuron (Madaline), Back propagation network

UNIT – III :

Unsupervised Learning Neural Networks: Kohonen self organizing networks, Adaptive resonance theory.
Associate Memory Networks: Bidirectional associative memory network, Hopfield networks.

UNIT – IV

Fuzzy logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT – V

Genetic algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Simple genetic algorithm, General genetic algorithm, Classification of genetic algorithm, Machine Learning Approach to Knowledge Acquisition.

Textbook:

1. S.N. Sivanandam & S.N. Deepa, “Principles of soft computing”, Wiley publications, 2nd Edition, 2011.
2. LiMin Fu, “Neural Networks in Computer Intelligence”, McGraw-Hill edition, 1994.

Suggested Readings:

1. S. Rajasekaran& G.A. Vijayalakshmipai, “Neural Networks, Fuzzy logic & Genetic Algorithms, Synthesis &Applications”, PHI publication, 2008.
2. K.L.Du& M.N.S Swamy, “Neural Networks in a Soft Computing Framework”, Springer International edition, 2008.
3. Goldberg, David E., “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, New Delhi,2008.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs13/preview.
2. https://archive.nptel.ac.in/courses/106/105/106105173/

23CSE 116

DEEP LEARNING
Elective-III

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Artificial Intelligence, Machine Learning.

Course Objectives:
1. To learn the fundamentals of deep learning and the main research activities in this field.
2. To acquire the knowledge of Deep learning methods, models, Optimizations, Regularizations and algorithms.
3. To understand CNN, RNN, Transformers and GANs along with their applications.

Course Outcomes: The Student will be able to
1. Understand various optimization techniques used in deep learning.
2. Analyze various Auto encoders and Regularization Techniques.
3. Design and Develop various Convolution Neural Networks architectures.
4. Analyze various RNNs and Encoder Decoder Models.
5. Understand the importance of Transformers, GANs and Federated Learning to develop real-time applications.
6. Evaluate the Performance of different models for deep neural network training.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	2	-	-	-	-	-	-
CO 2	2	2	2	2	2	-	-	-	-
CO 3	2	2	-	2	2	1	1	1	1
CO 4	2	2	2	2	2	-	-	-	1
CO 5	3	2	2	1	-	-	1	1	2
CO 6	3	3	3	2	2	2	1	1	2

UNIT - I

Introduction: Introduction, Historical Trends in Deep Learning.

Optimization: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

UNIT - II

Autoencoders: relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, **Regularization**: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

UNIT - III

Convolutional Neural Network: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types.

LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks

UNIT – IV

Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs Encoder Decoder Models, Attention Mechanism, Attention over images

UNIT – V

Transformers: Getting Started with the model architecture of the Transformer, Fine Tuning BERT Models.

Generative Adversarial Networks (GANs): Introduction, Discriminator, Generator, Activation, Common activation functions for GANs, BCE loss, Conditional GANs, Controllable generation, real life GANs

Federated Learning: Introduction, Distributed Machine Learning

Text Books:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Rothman, Denis, "Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", Packt Publishing Ltd, 2021.
3. Ganguly Kuntal, "Learning generative adversarial networks: next-generation deep learning simplified", Packt Publishing, 2017.
4. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang,Tianjian Chen,Han Yu "Federated Learning", Morgan & Claypool Publishers, 2020.

Suggested Reading:

1. Tom M. Mitchell, "Machine Learning ",MacGraw Hill, 1997.
2. LiMin Fu, "Neural Networks in Computer Intelligence", McGraw-Hill edition, 1994.
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
4. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
5. Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow by Benjamin Planche, Eliot Andres, Packt Publishers, 2019
6. Tunstall, Lewis, Leandro von Werra, and Thomas Wolf, "Natural Language Processing with Transformers ", O'Reilly Media, Inc., 2022.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85/

23CSE 117

BIG DATA ANALYTICS
Elective-III

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Data Mining

Course Objectives:

1. To optimize business decisions and create competitive advantage with Big Data analytics.
2. To learn to analyze Big Data using intelligent techniques.
3. To introduce programming tools PIG & hive in Hadoop echo system

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

1. Illustrate big data challenges in different domains including social media, transportation, finance and medicine.
2. Enumerate and apply the features of Cassandra.
3. Design and develop Hadoop and MapReduce programs.
4. Perform data analysis using Apache Spark
5. Analyze the data analytics process with a case study.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	2	2	2	-	1	1	1
CO 2	3	1	1	2	2	-	-	-	1
CO 3	3	3	3	2	2	-	2	2	1
CO 4	3	3	3	2	2	-	2	2	1
CO 5	3	3	3	2	2	-	2	2	1

UNIT – I

Types of Digital Data: Classification of Digital Data. Introduction to Big Data: Characteristic of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, what is Big Data? Big Data Analytics: Where do we Begin? What is Big Data Analytics? What Big Data Analytics isn't? Classification of Analytics, Terminologies Used in Big Data Environments. The Big Data Technology Landscape: NoSQL.

UNIT – II

Introduction to Cassandra: Apache Cassandra - An Introduction, Features of Cassandra, CQL Data Types, CQLSH, Key spaces, CRUD, Collections, Using a untt Counter, Time to Live, Alter Commands, Import and Export.

UNIT – III

Hadoop: Hadoop Overview, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator). MAPREDUCE: Introduction to MAPREDUCE Programming: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

UNIT – IV

Introduction to Data Analysis with Spark: What is Apache Spark, A unified Spark, who uses Spark and for what? A Brief History of Spark, Spark version and releases, Storage layers for
Spark. Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence.

UNIT – V

Jasper Report using Jaspersoft: Introduction to Jasper Reports, connecting to MongoDB NoSQL Database, Connecting to Cassandra NoSQL Database. Few Interesting Differences: Difference between Data Warehouse and Data Lake, Difference between RDBMS and HDFS, Difference between HDFS and HBase, Difference between Hadoop MapReduce and Spark, Difference between Pig and Hive

Textbook:

1. Big Data and Analytics by Seema Acharya, Subhashini Chellappan, Second Edition, Wiley India Pvt Ltd., 2019
2. Learning Spark: Lightning-Fast Big Data Analysis by Andy Konwinski, Holden Karau, Matei Zaharia, Patrick Wendell, First Edition, O'Reilly, 2015

Reference Books:

1. Big Data Analytics, by Radha Shankarmani, M Vijayalakshmi, Second Edition, Wiley India Pvt.Ltd.,2016
2. Bill Franks:-Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Media, Inc., 2009
4. .Bart Baesens,-Analytics in a Big Data World: The Essential Guide to Data Science and its Applications(WILEY Big Data Series),John Wiley & Sons, 2014

Online Resources:

1. http://hadoop.apache.org/
2. https://nptel.ac.in/courses/l06104189
3. https://www.edx.org/course/big-data-flindamentals
4. https://www.coursera.org/specializations/big-data
5. https://www.wileyindia.com/big-data-and-analytics-2ed.html

23CSE 118

ARTIFICIAL INTELLIGENCE FOR ROBOTICS
Elective-III

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The objectives of this course are

1. To understand the foundation for robotics and AI
2. Learn the real-time problem solving with AI enabled robots
3. Gain the knowledge on hardware and software aspects of AI enabled robots
4. To explore the real world applications of AI enabled robots
5. To learn the associated technologies for building sophisticate robots to solve complex problems.

Course Outcomes:

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

1. Understand the Observe-Orient Decide-Act (OODA) AI framework
2. Analyze the techniques that allow the robot to learn for itself
3. Explore object recognition methods
4. Illustrate robot navigation
5. Analyse Robot Emotion Engine

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	-	3	-	-	2	-	-	-	-
CO 2	-	-	3	2	-	-	-	-	-
CO 3	-	3	-	2	-	-	-	-	-
CO 4	-	-	3	2	-	-	-	-	-
CO 5	-	3	-	3	2	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-

UNIT – I

Foundation for Robotics and AI, the robot architecture, ROS,
Setting up the software and hardware for the construction of the robot

UNIT – II

A systems engineering-based approach to robotics
Object Recognition Using Neural Networks and Supervised Learning

UNIT – III

Techniques that allow the robot to learn for itself
Teaching the Robot to Listen, Robot speech recognition

UNIT – IV

Robot navigation including SLAM. Putting Things Away for obstacle avoidance, path planning, decision trees

UNIT – V

Giving the Robot an Artificial Personality, the Robot Emotion Engine, the Human
Emotion Model, and integrating personality rules into a chat bot-based conversation engine.
The future of AI and robotics

Textbook:

1. Francis X. Govers, “Artificial Intelligence for Robotics - Build intelligent robots that perform human tasks using AI techniques”, Packt Publishing, 2018
2. Danny Staple, “Learn Robotics Programming: Build and control AI-enabled autonomous robots using the Raspberry Pi and Python”, Packt Publishing, 2021.

Suggested Readings

1. Nikleia Eteokleous, Efi Nisiforou, ”Designing, Constructing and Programming Robots for Learning”, IGI Global Publishing, 2021

Online Resources:

1. https://roboticsindia.live/list-of-nptel-robotics-course-2022/
2. https://nptel.ac.in/courses/107106090

23CSE119

SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING
Elective-III

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Software Engineering.

Course Objectives:

The objectives of this course are

1. To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.
2. Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
3. Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

Course Outcomes:

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

1. Differentiate various software vulnerabilities and develop software to process vulnerabilities for an organization.
2. Evaluate various enterprise application design and development tools and standard practices.
3. Review techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
4. Know essential techniques for reducing and avoiding system and software security Problems.
5. Understand methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.
6. Solve enterprise-scale problems emanating from lapses in security requirements and information system management practices.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO 2	PEO 3
CO 1	2	1	1	-	1	-	1	1	-
CO 2	2	3	3	1	2	1	2	1	2
CO 3	1	1	-	1	1	1	-	-	2
CO 4	3	2	-	-	-	-	1	1	1
CO 5	2	1	1	1	-	-	1	-	2
CO 6	3	1	2	-	1	1	2	-	2

UNIT – I

Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, and Perform security testing and quality assurance.

UNIT – II

Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in an enterprise system, Present software solution.

UNIT – III

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/ DHCP/Terminal Services/Clustering/Web/Email).

UNIT – IV

Obtain the ability to manage and troubleshoot a network running multiple services, and understand the requirements of an enterprise network and how to go about managing them.

UNIT – V

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, and software containing minimum vulnerabilities and flaws.

Textbook:

1. Theodor Richardson, Charles N Thies, "Secure Software Design", Jones & Bartlett, 2012.
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley, 2015 E-book.

Online Resources:

1. https://www.coursera.org/specializations/secure-software-design

23CSE120

ADVANCED WIRELESS & MOBILE NETWORKS
Elective-III

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Data Communication and Computer Network

Course Objectives: The objectives of this course are

1. Learn the concepts of Wireless networks, protocol stack and standards
2. Understand the concepts of Mobile communication
3. Be familiar with internetworking of WLAN and WWAN
4. Learn the concepts of MANETs and Applications

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

1. To learn about evolution of 2G,3G,4G and 5G Networks, its architecture and applications
2. To understand the concepts of Mobile Communication
3. To understand the concept about Wireless networks, protocol stack and standards
4. To understand and analyze the network layer solutions for Wireless networks
5. To have in depth knowledge on internetworking of WLAN and WWAN
6. To Appraise the Knowledge on MANETs Architecture and its application

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	3	2	-	-	2	-	2
CO 2	1	2	-	2	-	-	2	-	1
CO 3	2	2	2	2	-	-	2	-	2
CO 4	2	2	3	1	-	-	1	-	2
CO 5	2	1	2	1	-	-	2	-	2
CO 6	1	2	1	1	-	-	2	-	2

UNIT – I

Introduction to Wireless Communication System: Evolution of Mobile Radio Communications, Cellular Phone Standards: 1G, 2G, 2.5G and 3G, FDD, TDD, FDMA, TDMA, CDMA, Cellular Telephone Systems, How a Cellular Telephone Call is Made.

Personal Communication Services (PCS) architecture, Global system for Mobile Communication (GSM) Architecture, GSM frequency spectrum , GSM radio aspects, GSM services, Supplementary services, GSM channel types, call processing in GSM

UNIT – II

Mobile Internet standard, Wireless Application Protocol (WAP) Gateway and Protocols. Wireless Mark-up Languages (WML) International Mobile Telecommunications 2000 (IMT 2000) specification. Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in third generation (3G) network. UMTS Technology: Features, UMTS data rates, UMTS Spectrum, UMTS Architecture, applications and advantages. Features of 4G and 4G LTE,VoLTE,4G and 5G Architecture.

UNIT – III

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT – IV

Wireless LAN- Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART

UNIT – V

MANET: MANET topologies, Features of MANET, Applications, types of MANET Architecture, Design challenges in MANET, Mesh Networking; Wireless sensor network, Applications, Clustering of WSN, Characteristics of WSN; Sensor node: Block diagram, Different types of WSN Architecture, Energy efficiency in WSN. WSN, MANET and IOT; ISO equivalent protocol layer architecture for WSN, Classification of clustering algorithms, Components of WSN Architecture.

Textbook:

1. Wireless and mobile network Architectures, Lin Yi-Bang, Clamtac Imrich , John Wiley &sons Publications
2. Wireless communications--principles and practice pearson 2nd edition T. S. Rappaport
3. Mobile Communications , Jochen Schiller, Second Edition, Pearson Education 2012

Suggested Readings:

1. Mobile Computing: Technology Applications And Service Creation, Asoke K. Talukder,2nd Edition

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee61/preview
2. https://www.digimat.in/nptel/courses/video/117104099/L01.html
3. https://www.digimat.in/nptel/courses/video/106106167/L01.html

23CSE126

NATURAL LANGUAGE PROCESSING
Elective-IV

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Basic knowledge of programming language such as python, Artificial Intelligence

Course Objectives:
The objectives of this course are
1. To gain knowledge on NLP
2. To understand morphological processing.
3. To familiarize with syntactic parsing, information extraction and probabilistic NLP.
4. Be capable of performing classification of text using Python's NLTK Library.

Course Outcomes:
On Successful completion of this course, student will be able to
1. Understand key concepts of NLP linguistics to describe and analyze language.
2. Understand the data structures and algorithms that are used in NLP.
3. Illustrate various text representation techniques in NLP.
4. Classify texts using machine learning and deep learning.
5. Apply NLP Pipe lines to solve real world applications.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	3	2	1	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-
CO4	2	3	3	2	-	-	2	-	3
CO5	3	3	3	2	1	2	2	-	3

UNIT - I
Language Processing and Python: Computing with Language: Texts and Words, Texts as Lists of Words, Computing with Language: Simple Statistics, Making Decisions and Taking Control, Automatic Natural Language Understanding.
Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet.

UNIT–II
Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings.
Categorizing and Tagging Words: Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation based Tagging.

UNIT - III
Text Representation: Vector Space Models Basic Vectorization Approaches, One-Hot Encoding Bag of Words, Bag of N-Grams, TF-IDF, Distributed Representations, Word Embedding, Going Beyond Words, Distributed Representations.

UNIT - IV
Learning to Classify Text: Supervised Classification, Evaluation, Naive Bayes Classifiers
Deep Learning for NLP: Introduction to Deep Learning, Convolutional Neural Networks, Recurrent Neural Networks, Classifying Text with Deep Learning.

UNIT-V

NLP applications :Topic modeling, Sentiment analysis , Word sense disambiguation, Speech recognition and speech to text, Text to speech, Language detection and translation, Recommender systems ,Question-Answering Systems, Social Media.

Text Books:

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana “Practical Natural Language Processing: A Comprehensive Guide to Building Real world NLP Systems”, O‟Reilly Media, Inc., 1st Edition, 2020.
2. Steven Bird, Ewan Klein, and Edward Lope ,”Natural Language Processing with Python”, O‟Reily, 2009
3. Akshay Kulkarni, AdarshaShivananda ,”Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python”, Apress, 2019

Suggested Reading:

1. Allen James, Natural Language Understanding, Benjamin/Cumming,1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.

Online Resources:

1. https://nptel.ac.in/courses/106101007/
2. http://www.cs.colorado.edu/~martin/sp2.html
3. https://web.standford.edu/~jurafsky/sp3/

23CSE127

Advanced Databases (Parallel, Multimedia, Distributed, NoSQL)
Elective-IV

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: **Database Knowledge and Basic programming**

Course Objectives:
At the end of the course student should
1. Design high-quality databases and database applications.
2. Translate complex conceptual data models into logical and physical database Designs.
3. Gain an understanding of NoSql
4. Have outline knowledge about Parallel and Distributed Databases
5. Gain experience in Performance Tuning

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the concept of distributed database and object oriented databases.
2. Develop temporal relationships with constraints
3. Gain the knowledge of Parallel databases
4. Understand the design and implement Distributed Databases.
5. Understand of modern data processing paradigms such as NoSQL and Map Reduce.
6. Store and retrieve multimedia data..

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	-	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	-	2	1	-
CO 3	2	-	-	-	-	-	1	1	-
CO 4	2	2	-	-	-	-	1	1	-
CO 5	2	2	-	-	-	-	1	-	-
CO 6	2	2	-	-	-	-	1	-	-

UNIT - I

Object Based Database Systems
Object Database Concepts Overview: Object Oriented Concepts and Features, Object Identity, Complex data types, Encapsulation of Operations and Object Persistence, Type Hierarchies and Inheritance. Object Based Extensions to SQL: User-Defined Types using CREATE TYPE and Complex Objects ODMG Object Model and the Object Definition Language.

UNIT - II

Temporal Database Systems
Temporal Data model: Conceptual Objects, Temporal Objects, temporal Constraints, Temporal and Non Temporal Attributes, Conceptual Relationships, Temporal Relationships and constraints among relationships. The Temporal Query Language: Temporal Projection, Temporal Selection, Temporal Version Restriction Operators, Temporal Scope Operators.

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UNIT - III

Parallel Database Systems:

I/O Parallelism: Partitioning Techniques, Managing Skew. Interquery Parallelism and Intraquery Parallelism, Intra-operator Parallelism (Parallel Sort and Parallel Join).Inter-operator Parallelism: Pipelined Parallelism and Independent Parallelism Query Optimization.

UNIT - IV

Distributed Database Systems:

Distributed Database Concepts. Data Fragmentation, Replication and Allocation Techniques For Distributed Database Design, Concurrency Control and Recovery.

NOSQL Databases: Introduction, the CAP theorem, Document based NOSQL systems and MongoDB, NOSQL Key-Value Stores, Column Based NOSQL Systems, NOSQL Graph Databases and Neo4j.

UNIT-V

Creating Distributed Multimedia Presentations: Objects in Multimedia Presentations, Specifying Multimedia Documents with Temporal Constraints, Efficient Solution of Temporal Presentation Constraints, Spatial Constraints. Distributed Media Servers: Distributed multimedia server architecture, distributed retrieval plans, optimal distributed retrieval plans.

Text Book:

1.Advanced Database Systems by Nabil R. Adam and Bharat K . Bhargava, ISBN 3-540-57507-3 Springer-Verlag Berlin Heidelberg New York.

2. V.S. Subrahmanian, Principles of Multimedia Database Systems, Morgan Kauffman.

Recommended Books:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition,Pearson Education, 2017
2. ADVANCED DATABASE SYSTEMS by Dr.John Kandiri
3. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", 6th Edition,2014
4. Multimedia Databases: An object relational approach, Lynne Dunckley, Pearson Education.
5. Multimedia Database Systems, Prabhakaran, Springer.

23CS E128

VIRTUAL, AUGMENTED, MIXED & EXTENDED REALITY
Elective-IV

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Programming for problem solving, Internet and web technologies, machine learning, Computer Vision.

Course Objectives:
The student should be made
1. To explore the history of spatial computing and design interactions.
2. To understand the fundamental principles describing how hardware, computer vision algorithms work
3. To learn Virtual reality animation and 3D Art optimization.
4. To demonstrate Virtual reality.
5. To develop visualization tools.

Course Outcomes:
At the end of the course, the student should be able to:
1. Describe how VR & AR systems work and list the applications of VR & AR.
2. Understand and analyse the hardware requirements of VR & AR.
3. Identify and Use the VR & AR software technologies .
4. Analyse and understand the working of various state of the art AR devices
5. Acquire knowledge of mixed reality

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	1	2	2	-	-	-	-	-	-
CO2	-	3	1	-	-	-	-	-	-
CO3	-	3	1	-	-	-	-	-	-
CO4	2	3	2	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-

UNIT – I
Virtual Reality and Virtual Environment: The historical development of VR –Scientific landmarks Computer Graphics, Real-time Computer Graphics, Flight Simulation, Virtual environments, Requirements of VR, Benefits of Virtual reality.
3D User Interface Input Hardware: Input device characteristics, Desktop input devices, Tracking devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home-Brewed Input Devices, Choosing Input devices for 3D interfaces.

UNIT – II
Software Technologies: VR Environment –VR Database, Tessellated Data, LODs, Cullers and Occluders , Lights and Cameras, Scripts, VR toolkits, Available software in the market.
3D Interaction Techniques: 3D Manipulation tasks, Manipulation techniques and Input devices, Interaction Techniques for 3D Manipulation.

UNIT -III
Designing and Developing 3D User Interfaces: Strategies for Designing and Developing Guidelines and Evaluation.
Virtual Reality Applications: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.

UNIT -IV

What Is Augmented Reality - Defining augmented reality, history of augmented reality, applications of augmented reality.

Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception , Requirements and Characteristics, Spatial Display Model.

Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT -V

Beyond A. R. - Mixed Reality : 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.

TEXT BOOKS:

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008

2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

3. Allan Fowler-AR Game Development, 1st Edition, A press Publications, 2018, ISBN 978- 1484236178 2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494

Reference Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381

E-Books:

1. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
2. https://docs.microsoft.com/en-us/windows/mixed-reality/
3. https://docs.microsoft.com/en-us/archive/msdn magazine/2016/november/hololensintroduction-to-the-hololens

MOOC Courses:

1. https://www.coursera.org/learn/ar
2. https://www.udemy.com/share/101XPi/

23CSE129

BLOCK CHAIN TECHNOLOGY
Elective-IV

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Distributed Systems, Computer Networks.

Course Objectives:
The objectives of this course are to
1. Introduce the fundamental design and architectural primitives of Blockchain and consensus protocols.
2. Explore various blockchain platforms.
3. Understand and develop smart contracts and decentralized applications.
4. Understand the significance of Hyperledger Fabric and composer.
5. Apply blockchain securely in various sectors ranging from Financial to Government.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the fundamental design and architectural primitives of Blockchain and consensus protocols.
2. Explore various blockchain platforms and identify the significance of smart contracts.
3. Identify the working of Ethereum and decentralized applications.
4. Implement the blockchain applications with Hyperledger Fabric and Composer.
5. Apply blockchain in different application domains such as financial and supply chain sectors.
6. Analyze the Implications of blockchain for privacy and security.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	1	1	1	-	-	-	-	-	1
CO2	1	1	1	-	-	-	-	-	-
CO3	1	1	1	1	-	-	-	-	-
CO4	1	1	1	1	-	-	1	1	1
CO5	1	1	1	1	-	-	1	1	1
C06	1	1	1	1	-	-	1	1	1

UNIT – I
Introduction to Blockchain: Basics, History, Need of Blockchain, Architecture, Blockchain components, Merkle Tree, Transactions, Hash functions, digital signatures.
Consensus Protocols: Proof of Work (PoW), Proof of Stake (PoS), Permissioned Blockchain: RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance.

UNIT – II
Introduction to blockchain platforms: Ethereum, Hyperledger, IBM Blockchain, BigChainDB, IPFS, Dapps.
Introduction to smart contracts: Basic description of smart contracts, history of smart contracts, smart contracts operations and management.

UNIT – III
Ethereum Blockchain-concepts and terminologies, Transaction and Block in Ethereum, Ethereum Client, Mist Wallet, Accounts, Ethereum Smart Contracts, Ethereum Virtual Machine (EVM), Byte Code interpretation, Ethereum mining reward scheme, gas pricing.
Decentralized application development: Introduction to DApps development, Native application development using Java (with RPC) verses JavaScript applications.

UNIT – IV

Hyperledger Fabric – Blockchain for Enterprise, Overview, Transaction Flow, Hyperledger Fabric Details, Fabric – Membership and Identity Management, Hyperledger Fabric Network Setup, Hyperledger Composer – Application Development.

Use Case I : Blockchain in Financial Service : Payments and Secure Trading, Compliance and Mortgage, Financial Trade.

UNIT – V

Use Case II: Blockchain in Supply Chain, Blockchain in Government: Digital Identity, Applications in the field of Healthcare and Education Sector, Use Case III : Implications of blockchain technology for digital privacy and Security.

Text Books:

1. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020, ISBN: 9781839213199.
2. Herbert Jones, Blockchain (1 ed.), Create Space Independent Publishing Platform, 2017. ISBN 978-1977971708.
3. Larry A. DiMatteo, Michel Cannarsa, Cristina Poncib, The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms (1 ed.), Cambridge University Press, 2019. ISBN 978-1108492560.

Suggested Reading:

1. Josh ThomPEOn, „Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Create Space Independent Publishing Platform, 2017.
2. Gaur and Nitin, Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric an (1 ed.), Packt Publishing Ltd, 2018. ISBN 978-1788994521.

Online Resources:

1. https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199
2. https://www.cse.iitk.ac.in/users/emasters/courses/Introduction%20to%20Blockchain%20Technology.ht ml
3. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
4. https://onlinecourses.nptel.ac.in/noc20_cs01/preview

23CS E130

PARALLEL AND HIGH PERFORMANCE COMPUTING
Elective-IV

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Computer Organization, Operating Systems

Course Objectives:
The main objectives of this course are to:

1. Understand the concepts of Parallelism, computing environments and HPC ecosystems.
2. Learn various parallel algorithms and strategies
3. Study parallel languages and HPC ecosystems

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

1. Understand the concepts various levels of parallelisms, GPU programming models and, HPC ecosystems.
2. Identify the performance limits and profiling of computer programs
3. Analyse the complexities of parallel algorithms.
4. Develop parallel applications using OpenMP.
5. List tools and resources for better coding

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	-	1	2	-	-	1	-	2
CO2	2	1	1	2	-	-	2	1	-
CO3	2	3	2	1	-	-	1	-	2
CO4	3	2	2	2	-	-	1	-	1
CO5	2	2	3	2	-	-	2	1	1
C06	2	-	1	2	-	-	1	-	2

UNIT – I
Parallel Computing: Introduction, need and benefits of parallel computing, Fundamental laws of parallel computing, working of parallel computing, Hardware Model for heterogeneous parallel systems, application/software model, Parallel Approaches and strategies, Parallel vs comparative speedups

UNIT – II
Parallel Program Development and Algorithms: Parallel program development cycle, performance limits and profiling. Parallel Algorithms analysis, complexity, Spatial Hashing, Prefix sum pattern and its importance in parallel computing

UNIT – III
CPU for Parallel Computing: Vectorization- vectorization and SIMD, vectorization methods, compiler flags for vectorization, Multi-core and Threading- OpenMP, Distributed Memory- MPI examples.

UNIT – IV
GPUs: GPU architecture and benefits, Programming models for GPUs, OpenACC and OpenMP, GPU languages, profiling tools.

UNIT – V
High Performance Computing Ecosystems: Affinity, File operations for parallel world: components of a high-performance filesystem, standard file operations, HDF5, Overview of tools and resources for better code.

Textbook:

1. Robert Robe, Yuliana Zamora, “Parallel and High Performance Computing”, Manning Publications, 2021
2. Charles Severance, Kevin Dowd, “High Performance Computing”, OpenStax CNX, 2021

Suggested Readings:

1. Peter Pacheco, “Introduction to Parallel Programming”, Morgan Kaufmann Publishers, 2011
2. Michael J. Quinn, “Parallel programming in C with MPI and OpenMP”, McGraw-Hill Higher Education, 2004
3. William Gropp, “Using MPI: portable parallel programming with the message-passing interface”, MIT press, 1999

Online Resources:

1. https://archive.org/details/cnx-org-col11136/page/n57/mode/2up

23CSC107

ADVANCED DATABASES LAB AND SOFT COMPUTING LAB

Laboratory 3

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives:

1. To develop database applications using object relational mappings and XML
2. To implement algorithms for query processing engine
3. To develop simple applications using Hadoop and map reduce framework
4. Fundamentals of Neural Networks & Feed Forward Networks, Associative Memories & Artificial Neural Networks.
5. Understanding the concepts of Fuzzy Logic and Fuzzy Systems, Genetic Algorithms and its design.

Course Outcomes:

After Completion of the course Students will be able to:

1. Develop database applications in object relational database concepts
2. Develop database application using hybernet frame work
3. Implement data processing applications using Hadoop and map reducing framework
4. Apply perceptron learning algorithm for a given problem.
5. Design and analyze various Neural Networks Architectures.
6. Apply soft computing strategies for various real time applications

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	2	1	1	1	1	-	1	-	-
CO2	2	2	2	2	2	-	2	3	-
CO3	3	2	3	1	3	-	3	2	-
CO4	1	2	3	1	1	-	1	2	-
CO5	2	2	3	1	2	-	2	3	-
CO6	2	2	3	1	2	-	2	3	-

List of programs: Implement the following programs

1. Design a database application using object relational database
2. Design a database application using persistent programming language
3. Design a database application using hibernate
4. Create XML database and write queries using XQuery and XPath
5. Implement relational algebra operations
   a. Selection operation b. Hass Join c. Merge Join
6. Implement parallel join and parallel sorting
7. Use visualization tools to draw query plans
8. Using Hadoop for counting word frequency with Map Reduce.
9. Write a Map Reduce Application which processes a log file of a system. List out theusers who have logged for max period on the system. Use sample Log file from the internet and process it using a pseudo distribution mode on Hadoop platform.
10. Implementation of Simple Neural Network (McCulloh-Pitts model) for realizing AND Operation and OR operation.
11. Implementation of Perceptron network for realizing OR and NAND operation.
12. Implementation of ANDNOT using ADALINE network.
13. Implementation of XOR problem using MADALINE network.
14. Design and implementing the Back Propagation Algorithm for training a non-linear network.
15. Implementation of Hopfield Network.

Textbook:

1. S.N. Sivanandam & S.N. Deepa, “Principles of soft computing”, Wiley publications, 2nd Edition,2011.

Suggested Reading:

1. D.K Prathikar, “Soft Computing”, Narosa Publishing House, New Delhi, 2008.
2. S.N.Sivanandam, S.N.Deepa “Principles of Soft Computing” Second Edition, Wiley Publication 2016.
3. Satish Kumar, "Neural Networks -A classroom approach"; Second Edition, TMH, 2017.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs54/preview

23CSE120

ADVANCE WIRELESS AND MOBILE NETWORKS LAB

(Based on Electives III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Data Communication and Computer Networks

Course Objectives: The objectives of this course are

1. To familiarize students with the Wireless communication media, devices, and protocols.
2. To expose students to gain practical knowledge of Wireless networks configuration and monitoring
3. To create simple wireless computer networks using simulation/emulator tools.

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

1. Identify the different types of Wireless modules and Equipment.
2. Design and demonstrate Wireless network topologies
3. Practice the basic network commands like AT in GSM
4. Analyze the network traffic in various Network Simulators or Emulators
5. Design and develop wireless wide Area networks
6. Design a Mobile Ad hoc Network(MANET) and analyse the application of MANET

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	1	-	3	2	-	-	2	-	2
CO 2	2	3	2	2	-	-	2	-	2
CO 3	2	-	1	-	-	-	1	-	1
CO 4	-	3	2	2	-	-	2	-	2
CO 5	2	3	1	2	-	-	2	-	2
CO 6	2	3	2	2	-	-	2	-	2

List of Experiments:

1) Simulate a Simple Local Area Network Using 802.11 standard (Use Arduino/Raspberry Pi)
2) Create a Personal Area Network using Blue tooth Modules (
3) Build a Simple Network using 802.16 standard (Use X-Bee Module)
4) Build a Simple LoRa Network which can send a message over a long distance(50 KM to 100 KM)
5) Build a Wireless Wide Area Network using LoRa WAN Module
6) Basic OSPF configuration using GNS3 tool
7) Basic EIGRP Configuration using GNS3 tool
8) Simulate the line coding techniques using MATLAB Simulink.
9) Simulate a MANET using Raspberry Pi board
10) Develop a Wireless Sensor Network using open source simulators or emulators like Cupcarbon/GNS3 simulator
11) Develop a program to Send and Receive a Message using GSM Module (Ex: SIM990A)

Textbook:

1. Wireless communications--principles and practice Pearson 2nd edition T. S. Rappaport
2. Mobile Communications , Jochen Schiller, Second Edition, Pearson Education 2012

Suggested Readings:

1. Wireless Communications (IEEE Press), Andreas F. Molisch, Second Edition, Wiley,2012

Online Resources:

1. https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks
2. https://vlab.amrita.edu/?sub=78&brch=256

23CSE 121

DEEP LEARNING LAB
(Based on Electives III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Artificial Intelligence, Machine Learning

Course Objectives:

The objectives of this course are to:

1. Understand basic concepts of Deep learning and their applications.
2. Evaluating Deep learning methods, models and algorithms.
3. Analyzing CNN, RNN, Transformers and GAN along with their applications

Course Outcomes:

On successful completion of this course the student will be able to

1. Evaluate the performance various optimization techniques used in deep learning.
2. Analyze various Auto encoders and Regularization Techniques.
3. Design and develop various Convolution Neural Networks architectures.
4. Analyze various RNNs and Encoder Decoder Models.
5. Understand the importance of Transformers and GANs to develop real-time applications.
6. Evaluate the Performance of different models for deep neural network training.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	3	2	1	-	-	-	1
CO 2	3	3	3	2	1	-	-	-	1
CO 3	3	2	-	2	1	-	-	-	1
CO 4	3	2	3	2	1	-	-	-	1
CO 5	2	1	-	-	-	1	1	1	2
CO 6	3	2	3	2	2	-	-	-	2

List of Experiments

1. Implementation of Classification with Multilayer Perceptron using Scikit-learn with MNIST Dataset.
2. Understanding of Deep learning Packages Basics: Tensorflow, Keras, Theano and PyTorch.
3. Compare the Performance of various Optimization techniques of Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.
4. Implementation of Denoising autoencoders, Sparse autoencoders and Contractive autoencoders.
5. Compare the Performance of the Classification model using various Regularization Techniques.
6. Train a Deep learning model to classify a given image using pre trained model of AlexNet VGGNet, GoogLeNet, ResNet and compare their performance.
7. Implementation of RNN for text generation.
8. Implementation of Encoder Decoder Models
9. Understand the Finetuning of BERT Models
10. Implementation of GANs for generating synthetic data.

Text Books

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Learning Generative Adversarial Networks: Next-generation deep learning simplified by Kuntal Ganguly, Packt, 2017
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

Suggested Readings

1. Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow by Benjamin Planche, Eliot Andres, Packt Publishers, 2019
2. Huang, Shih-Chia, and Trung-Hieu Le. Principles and labs for deep learning. Academic Press, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85/

23CSE122

BIG DATA ANALYTICS LAB

(Based on Electives III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-Requisites: Database Management, Programming, Statistic and Mathematics, Machine Learning, Distributed Computing, Critical thinking and Problem Solving.

Course Objectives:

1. To provide a practical learning environment where students or researchers can gain hands-on experience with big data analytics techniques, tools, and technologies.
2. To foster a deeper understanding of the concepts, challenges, and opportunities associated with big data analytics.
3. To equip participants with the necessary skills, knowledge, and practical experience to tackle real-world big data challenges and make informed decisions based on data-driven insights.

Course Outcomes:

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

1. Identify the key issues in big data management and experiment with the Hadoop framework.
2. Develop problem solving and critical thinking skills in fundamental enable techniques like Hadoop & MapReduce. Construct and Explain with structure and unstructured data by using NoSQL commands.
3. Implement fundamental enabling techniques and scalable algorithms for data stream mining.
4. Implement scientific computing algorithms for finding similar items and clustering.
5. Analyze the algorithms of big data analytics in various applications like recommender systems, social media applications.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	3	2	2	2	-	1	1	1
CO 2	3	1	1	2	2	-	-	-	1
CO 3	3	3	3	2	2	-	2	2	1
CO 4	3	3	3	2	2	-	2	2	1
CO 5	3	3	3	2	2	-	2	2	1

List of Experiments:

1. Installation of Hadoop Framework, its components and study of the HADOOP ecosystem.
2. Write a program to implement word count program using MapReduce
3. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce Matrix multiplication.
4. Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
5. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language
6. Implement and Perform Streaming Data Analysis using flume for data capture, PYSpark/HIVE for data analysis of twitter data, chat data, weblog analysis etc.
7. Implement any one Clustering algorithm (K-Means/CURE) using Map-Reduce.
8. Implement Page Rank Algorithm using Map-Reduce.

Mini Project:

One real life large data application to be implemented (Use standard Datasets available on the web).

Textbooks:

1. Hadoop: The Definitive Guide, 4th Edition Paperback – 1 January 2015
2. MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems Paperback – Import, 7 December 2012
3. Learning Spark: Lightning-Fast Big Data Analysis Paperback – 13 February 2015
4. NoSQL for Mere Mortals Paperback – 16 April 2015

Online Resources :

1. https://hadoop.apache.org/
2. https://docs.mongodb.com/
3. https://cassandra.apache.org/doc/
4. https://hbase.apache.org/

23CSE 123

ARTIFICIAL INTELLIGENCE FOR ROBOTICS LAB

(Based on Electives III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-Requisites: Artificial intelligence, IoT.

Course Objectives:

1. Build real-world Artificial Intelligence applications with Python
2. To program the robots to intelligently interact with the world around you

Course Outcomes:

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

1. Identify the key issues robot programming
2. Develop problem solving and critical thinking skills to build AI enabled robots.
3. Implement object recognition methods
4. Implement toy pick-up robot and voice command response robot
5. Analyze the human emotion-model

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	-	3	-	-	2	-	-	-	-
CO 2	-	-	3	2	-	-	-	-	-
CO 3	-	3	-	2	-	-	-	-	-
CO 4	-	-	3	2	-	-	-	-	-
CO 5	-	3	-	3	2	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-

List of Experiments:

1. Installation and configuration of Linux, Robotic Operating System (ROS), Raspberry Pi 3, Arduino, Python 2.7 or 3.5, with NumPy, SciPy, Matplotlib, and scikit
2. Creating the Ubuntu Linux virtual machine under VirtualBox
3. Assemble the robot from the components available.
4. Object Recognition Using Neural Networks and Supervised Learning : create a CNN to examine images. Train the network on two sets of images – one containing toys and one without toys. Ttrain the network to get better than 90% accuracy in classifying images as either having toys, or not having toys. Teste the network to verify its output.
5. Program the robot to Pick up the toys and place them in the toys box.
6. Teaching a robot to listen and respond, understand some commands
7. Avoiding the staircase / objects
8. Giving the Robot an Artificial Personality through the Robot Emotion Engine Simulate personality: Have moods Have feeling Show empathy, Interact with people

Mini Project:

One real life large application to be implemented

Textbooks:

1. Francis X. Govers, “Artificial Intelligence for Robotics - Build intelligent robots that perform human tasks using AI techniques”, Packt Publishing, 2018
2. Danny Staple, “Learn Robotics Programming: Build and control AI-enabled autonomous robots using the Raspberry Pi and Python”, Packt Publishing, 2021
3. Prateek Joshi, “Artificial Intelligence with Python”, Packt Publishing, 2017

Online Resources :

1. http://github.com/fgovers/ai_and_robots.
2. https://robots4autism.com/
3. https://github.com/PacktPublishing/Artificial-Intelligence-for-Robotics/chapter4

23CSE124

SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING LAB

(Based on Elective-III Lab)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Software Engineering.

Course Objectives:

The objectives of this course are

1. To make students aware of various issues like weak random number generation, information leakage, poor
2. usability, and weak or no encryption on data traffic.
3. Techniques for successfully implementing and supporting network services on an enterprise scale and
4. Heterogeneous systems environment.
5. Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

Course Outcomes:

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

1. Develop a security model for any enterprise-based application on its threats and vulnerabilities.
2. Implement methodologies and tools to design secure software enterprise application.
3. Compare different types of threats and attacks.
4. Implement the various security algorithms to be implemented for secured computing and computer networks.
5. Evaluate various methods of authentication and access control for web-based applications.
6. Analyse and apply different anti-intrusion techniques.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	1	-	-	1	-	1	1	1
CO 2	2	1	3	-	1	1	1	1	-
CO 3	1	1	-	-	1	-	1	-	-
CO 4	2	1	2	1	1	1	1	-	1
CO 5	1	-	1	-	1	1	-	-	-
CO 6	1	-	1	-	1	1	1	1	2

List of Experiments:

1. Learn the types of Security Testing.
2. Study of multi-tier software environment.
3. Study of web servers / web browser and Tools for enterprise software Development and deployment.
4. Develop a package using JDBC.
5. Develop a package using servlets / JSP.
6. Study of System threat attacks - Denial of Services.
7. Implementation of S-DES algorithm for data encryption.
8. Implementation of Asymmetric Encryption Scheme – RSA.
9. Study of Symmetric Encryption Scheme – RC4.
10. Study of Techniques uses for Web Based Password Capturing.
11. Study of Anti-Intrusion Technique – Honey Pot.

Suggested Readings:

1. Paul J Perrone, Venkata S.R. Krishna R and Chayanti, “Building Java Enterprise Systems with J2EE”, Techmedia , New Delhi, 2000.
2. George Reese, “Database programming, with JDBC and Java” Second Edition, O’Reiliy Publishers, New Delhi, 2000.

23CSE125

ADVANCE WIRELESS AND MOBILE NETWORKS LAB

(Based on Elective-III Lab)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	- Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Data Communication and Computer Networks

Course Objectives:

The objectives of this course are

1. To familiarize students with the Wireless communication media, devices, and protocols.
2. To expose students to gain practical knowledge of Wireless networks configuration and monitoring
3. To create simple wireless computer networks using simulation/emulator tools.

Course Outcomes:

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

1. Identify the different types of Wireless modules and Equipment.
2. Design and demonstrate Wireless network topologies
3. Practice the basic network commands like AT in GSM
4. Analyse the network traffic in various Network Simulators or Emulators
5. Design and develop wireless wide Area networks
6. Design a Mobile Ad hoc Network(MANET) and analyse the application of MANET

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	1	-	3	2	-	-	2	-	2
CO 2	2	3	2	2	-	-	2	-	2
CO 3	2	-	1	-	-	-	1	-	1
CO 4	-	3	2	2	-	-	2	-	2
CO 5	2	3	1	2	-	-	2	-	2
CO 6	2	3	2	2	-	-	2	-	2

List of Experiments:

1. Simulate a Simple Local Area Network Using 802.11 standard (Use Arduino/Raspberry Pi)
2. Create a Personal Area Network using Blue tooth Modules
3. Build a Simple Network using 802.16 standard (Use X-Bee Module)
4. Build a Simple LoRa Network which can send a message over a long distance(50 KM to 100 KM)
5. Build a Wireless Wide Area Network using LoRa WAN Module
6. Basic OSPF configuration using GNS3 tool
7. Basic EIGRP Configuration using GNS3 tool
8. Simulate the line coding techniques using MATLAB Simulink.
9. Simulate a MANET using Raspberry Pi board
10. Develop a Wireless Sensor Network using open source simulators or emulators like Cupcarbon/GNS3 simulator
11. Develop a program to Send and Receive a Message using GSM Module (Ex: SIM990A)

Textbook:

1. Wireless communications--principles and practice Pearson 2nd edition T. S. Rappaport
2. Mobile Communications , Jochen Schiller, Second Edition, Pearson Education 2012

Online Resources:

1. https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks
2. https://vlab.amrita.edu/?sub=78&brch=256

23CSC108

MINI PROJECT with SEMINAR

Instruction	4 Hours per week
Duration of End examination	-
Semester end examination	-
CIE	50 Marks
Credits	2

Pre-requisites: Programming Languages (Front-end and Back-end), Software Engineering, Software Project Management

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

1. Identify unsolved problems in domain space.
2. Demonstrate team work and sound theoretical knowledge on the problem context.
3. Analyse the problem with existing solutions and finalize the scope.
4. Design an optimized solution with flexible architecture to support future functionalities.
5. Demonstrate the knowledge, skills, and attitudes of a professional engineer.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	3	-	-	-	-
CO4	-		3	3	-	-	-	-	-
CO5	-	-	-	-	3	3	-	-	-

Guidelines:

- As part of the the curriculum in II-Semester, each student shall do a mini project. Generally student should work 3 to 4 weeks of prior reading, 12 weeks of active research, and and finally a presentationof their work for assessment
- Each student will be allotted to a faculty supervisor for monitoring the mini project work.
- Students are advised to select the mini project in such a way that they can demonstrate their competence in research techniques for the challenging issues/problems, and get an opportunity to contribute something more original.
- Mini projects shall have disciplinary/industry relevance.
- The students can select a mathematical modeling based/Experimental investigation or Numerical modeling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, detailed discuss on results, conclusions andreferences.

Department Committee: Supervisor and two faculty coordinators

Guidelines for awarding marks (CIE):	**Max. Marks: 50**	
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Writing

23CSC 109

DISTRIBUTED AND CLOUD COMPUTING

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

1. To learn about the concepts of distributed systems.
2. To understand distributed resource management.
3. To study the basics of cloud computing.
4. To study about virtualization and cloud resource management.
5. To be aware of different cloud platforms.

Course Outcomes:

On completion of the course, the students will be able to:

1. Designing and evaluation of algorithms and protocols for various distributed systems
2. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
3. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.
5. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.
6. Establish own cloud environment using Openstack and work on it.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	1	-	-	1	1	1	1
CO 2	2	3	2	-	-	-	1	1	-
CO 3	1	2	1	3	1	-	1	-	-
CO 4		1	3	1	2	1	1	-	1
CO 5	2	1	2	1	-	2	-	-	-
CO 6	2	1	1	2	1	2	1	1	2

UNIT - I

Introduction To Distributed System Concepts ,Introduction to Distributed Systems – Characteristics – Issues in Distributed Systems -Distributed System Model – Request/Reply Protocols – RPC – RMI – Logical Clocks and Casual Ordering of Events – Election Algorithm – Distributed Mutual Exclusion -Distributed Deadlock Detection Algorithms.

UNIT - II

Introduction to Cloud Computing – Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture– Architectural Design Challenges – Deployment Models: Public, Private and Hybrid Clouds – Service Models: IaaS – PaaS – SaaS – Benefits of Cloud Computing.

UNIT - III

Cloud Enabling Technologies: Introduction to Web Service and Service Oriented Architecture – SOAP – REST – Basics of Virtualization – Full and Para Virtualization- Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization -Server Virtualization.

UNIT - IV

Cloud Management: Storage And Security Resource Provisioning and Methods – Cloud Management Products – Cloud Storage – Provisioning Cloud Storage – Managed and Unmanaged Cloud Storage – Cloud Security Overview – Cloud Security Challenges –Security Architecture design – Virtual Machine Security – Application Security –Data Security.

UNIT V

Cloud Software and Computing PlatformsHDFS – Map Reduce – Google App Engine (GAE) – Programming Environment for GAE -Architecture of GFS – Case Studies: Openstack, Heroku, and Docker Containers -Amazon EC2, AWS, Microsoft Azure, Google Compute Engine.

Text Books:

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems – Principles and Paradigms", Second Edition, Pearson, 2006.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

References:

1. Mukesh Singhal, "Advanced Concepts In Operating Systems", McGraw Hill Series in Computer Science, 1994.
2. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley, 2011.
3. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation "Management and Security", CRC Press, 2010.

23CSE131

COMPUTER VISION
Elective-V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre Requisites: UG level Course in Linear Algebra and Probability.

Course Objectives:
The objectives of this course are
1. To understand the Fundamental Concepts Related To Multi-Dimensional Signal Processing.
2. To understand Feature Extraction algorithms.
3. To understand Visual Geometric Modeling and Stochastic Optimization.

Course Outcomes:
Upon completion of this course, students will be able to
1. Understand the basic principles of image processing and its significance in real world.
2. Interpret and evaluate various approaches for image. transformation, segmentation, and restoration.
3. Identify object, scene recognition and categorization algorithms for real time images.
4. Analyze images and videos for problems such as tracking and structure from motion.
5. Apply recovery of 3D structure of ill-posed scenes.
6. Model various techniques to build computer vision applications.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO 1	3	3	3		1		2	3	3
CO 2	3	3	3				2	3	3
CO 3	3	3	3	2			2	3	3
CO 4	3	3	3	2			2	3	3
CO 5	3	3	3	2			2	3	3
CO 6	3	3	3			2	2	2	2

UNIT - I
Image Formation and Description: Fundamental steps of image processing, the image model and Image acquisition, Sampling and quantization, Relationship between pixels. Sampling & Quantization, Elements of Digital Image Processing Systems.
Image Transforms: Digital Image Transforms - Fourier Transform, Extension to 2D.Properites of Fourier transformations.

UNIT - II
Image Enhancements: Histogram Equalization, Image Smoothing, Image Sharpening, Edge Detection.
Segmentation: Active contours, Split and merge, Mean shift and mode finding,Normalized cuts. Feature-based alignment: 2D and 3D feature-based alignment, Pose estimation.

UNIT - III
Structure from motion: Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, constrained structure and motion
Dense motion estimation: Translational alignment, parametric motion, Spline-based motion, Optical flow,Layered motion.

UNIT - IV

Recognition: Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding.

UNIT-V

3D Reconstruction: Shape from X, Active range finding, Surface representations, Point-based representations, Volumetric representations, Model-based reconstruction.

Textbooks:

1. R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008.
2. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.

Suggested Readings:

1. “Pattern Recognition: Statistical. Structural and Neural Approaches”; Robert J. Schallkoff; John Wiley and Sons; 1992.
2. “Computer Vision: A Modern Approach”; D. A. Forsyth and J. Ponce; Pearson Education; 2003.
3. "Multiple View geometry". R. Hartley and A. "Zisserman. 2002 Cambridge university Press".
4. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
5. K. Fukunaga; "Introduction to Statistical Pattern Recognition", Second Edition, Academic Press, Morgan Kaufmann, 1990.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_ee40.
2. CV online: http://homepages.inf.ed.ac.uk/rbf/CVonline.
3. Computer Vision Homepage: http://www2.cs.cmu.edu/afs/cs/project/ cil/ftp/ html/vision.html.

23CSE132

CLOUD IOT
Elective-V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: IoT, Cloud Computing

Course Objectives:

The objectives of this course are

1. Able to understand the IoT and Cloud importance.
2. Learn the real-time problem solving and applications with the integration of IoT with Cloud.
3. Gain the knowledge on IoT storage approaches.
4. Able to explore the real world applications in various fields like medical, agriculture etc.
5. To learn the extended technologies and their features in solving complex problems.

Course Outcomes:

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

1. Understand the basics of IoT, Cloud features and their technologies.
2. Analyze the networking and analyzing protocols
3. Explore and store the IoT data in webservers and cloud
4. Illustration of IoT integration with cloud in various fields
5. Pertain the knowledge of advancements in cloud with IoT

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	-	3	-	-	2	-	-	-	-
CO 2	-	-	3	2	-	-	-	-	-
CO 3	-	3	-	2	-	-	-	-	-
CO 4	-	-	3	2	-	-	-	-	-
CO 5	-	3	-	3	2	-	-	-	-

UNIT – I

Overview of IoT: Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT – II

IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics.

IoT Analytics for the Cloud: Introduction to elastic analytics, Decouple key components, Cloud security and analytics, Designing data processing for analytics, Applying big data technology to storage.

UNIT – III

Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis.

UNIT – IV

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Web Server – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

UNIT – V

Case studies for IoT integration with Cloud: Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City Cloud IoT Architecture. IoT Wearables, Health care systems, Agri and Allied sectors.

Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT architectural model,

Textbook:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A Hands on Approach", Universities Press, 2015.
2. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0 - by Giacomo Veneri and Antonio Capasso.

Suggested Readings:

1. IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security, 2nd Edition by Perry Lea.

23CSE133

GAME DESIGN & DEVELOPMENT
Elective-V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
The objectives of this course are
1. Understand the key principles and elements of game design.
2. Develop skills in creating compelling game mechanics and gameplay.
3. Gain proficiency in using industry-standard game development tools.
4. Learn the basics of game prototyping and playtesting.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Explore various aspects of game design, including level design and user experience.
2. Collaborate effectively in game development teams.
3. Apply critical thinking and problem-solving skills to game development challenges.
4. Develop an understanding of the game market and industry trends.

CO-PO Articulation Matrix

PO/PEO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	3	-	-	1	2	-	2
CO 2	2	1	2	-	-	1	1	1	-
CO 3	1	-	1	-	-	2	3	-	1
CO 4	-	2	1	-	-	1	1	-	-

UNIT - I
Introduction to Game Design: Introduction to game design concepts and terminology, The role of game designers and developers, Understanding player psychology and motivation, Case studies of successful games.

Game Development Tools and Technologies: Overview of popular game engines (e.g., Unity, Unreal Engine), Introduction to scripting and programming languages (e.g., C#, Python), Asset creation tools (e.g., Photoshop, Blender), Version control systems for collaborative development

UNIT - II
Game Mechanics and Gameplay: Elements of game mechanics (e.g., rules, objectives, progression), Designing engaging gameplay experiences, Balancing difficulty and challenge, Iterative game design process

Prototyping and Playtesting: Importance of prototyping in game development, Rapid prototyping techniques, Playtesting methodologies and feedback analysis, Iterative design based on playtest results

UNIT - III
Level Design and Environment Creation: Principles of level design and level flow, Creating immersive environments, Lighting and sound design, User interface design for games.

UNIT - IV
User Experience and Player Engagement: User experience (UX) design principles in games, Onboarding and tutorial design, Accessibility considerations in game design, Social and multiplayer interactions.

UNIT V
Game Development Project: Collaborative game development project in teams, Project scoping and management, Milestone deliverables and documentation, Testing and quality assurance.

Game Market and Industry Trends: Introduction to the game market landscape, Monetization models and business considerations, Emerging trends in game development (e.g., virtual reality, augmented reality), Career opportunities in the game industry

Textbooks:

1. "The Art of Game Design: A Book of Lenses" by Jesse Schell.
2. "Beginning Game Development with Python and Pygame: From Novice to Professional" by Will McGugan.

Suggested Readings:

1. "Level Up! The Guide to Great Video Game Design" by Scott Rogers.
2. "Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer" by Jim ThomPEOn and Barnaby Berbank-Green.

Online Resources:

1. https://www.gamedev.net/
2. https://www.gamasutra.com/
3. https://learn.unity.com/
4. https://www.unrealengine.com/en-US/onlinelearning
5. https://www.youtube.com/user/ExtraCreditz
6. https://gameanalytics.com/blog
7. https://www.coursera.org/.
8. https://www.reddit.com/r/gamedesign/

23CSE134 **DESIGN PATTERNS**
Elective-V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: A Course on Software Engineering and Object Oriented Programming through Java.

Course Objectives:
The main objectives of this course are
1. To appreciate the idea behind Design Patterns in handling common problems faced during building an application
2. To cover all pattern types from creational to structural, behavioural to concurrency and highlights the scenarios when one pattern must be chosen over others.
3. To construct design solutions by using adaptable patterns

Course Outcomes:
Upon completion of this course, students will be able to::
1. Understand software designs that are scalable and easily maintainable
2. Implement creational design patterns in software design for class instantiation
3. Analyze structural design patterns for better class and object composition
4. Use behavioural patterns for better organization and communication between the objects
5. Applying refactoring to better organize the class responsibilities of current code

CO-PO Articulation Matrix

PO/PEO CO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	2	2	-	-	1	-	1
CO 2	2	2	1	-	-	1	2	1	2
CO 3	2	2	2	2	-	-	3	-	2
CO 4	2	3	1	2	-	1	1	-	1
CO 5	2	2	2	-	-	-	2	1	2

UNIT - I
Introduction: What is a design pattern? design patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT – II
Design Patterns Catalog: Creational Patterns, Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.
Structural Pattern Part-I**:** Adapter, Bridge, and Composite and Structural Pattern Part-II**:** Decorator, Facade, Flyweight, Proxy.

UNIT – III
Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator,Memento, Observer, State, Strategy, Template Method, Visitor.

UNIT – IV
Architecture Pattern : Layered Architecture, Pattern Description, Key Concepts, Pattern Example, Considerations, Pattern Analysis

UNIT – V

Micro services Architecture Pattern : Pattern Description, Pattern Topologies, Avoid Dependencies and Orchestration, Considerations, Pattern Analysis

TEXT BOOKS:

1. Design Patterns, Erich Gamma, Pearson Education
2. Software Architecture Patterns, Mark Richards, O'Reilly Media, Inc.

REFERENCE BOOKS:

1. Pattern's in Java, Vol –I, Mark Grand, Wiley Dream Tech.
2. Patterns in Java, Vol-II, Mark Grand, Wiley Dream Tech.
3. Java Enterprise Design Patterns Vol-III, Mark Grand, Wiley Dream Tech.
4. Head First Design Patterns, Eric Freeman, O'reily publications

Online Resources:

1. http://www.oodesign.com/
2. http://ui-patterns.com/patterns/
3. http://sourcemaking.com/design_petterns
4. http://www.dmoz.org/computers/programming/methodologies/patterns_and_anti-patterns/

EXPERT DETAILS:

1. Erich Gamma, University of Zurich
2. Martin flower, martinfowler.com
3. Kent Beck, University of Oregon

23CS E135

CYBER SECURITY
Elective – V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Operating System, Computer Network and Cryptography.

Course Objectives:

The objectives of this course are

1. To identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
2. To collect, Process, Analyze and Present Computer Forensics Evidence.
3. To understand the legal perspectives and Organizational implications of Cyber Security

Course Outcomes:

On Successful completion of this course, student will be able to

1. List the different types of cybercrimes and analyze legal frameworks to handle cybercrimes.
2. Discuss the cyber offence and vulnerabilities in programming languages.
3. Identify the Tools and Methods used in cybercrimes.
4. Analyze and resolve cyber security issues and laws governing Cyberspace.
5. Describe the need of Digital Forensics and the importance of digital evidence in prosecution.
6. Interpret the commercial activities in the event of significant information security incidents in the Organization.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	2	2	2	2	1	1	1	1	1
CO 2	2	2	2	2	1	1	1	2	1
CO 3	3	3	3	3	3	2	1	2	2
CO 4	2	3	2	2	2	1	1	2	1
CO 5	3	3	3	2	2	2	1	2	2
CO 6	3	2	3	3	2	2	1	2	1

UNIT - I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective.

UNIT - II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Buffer Overflow, How Browsers Work, Google Dorking, Scanning the Entire Internet: Masscan and Shodan., Web Security.

UNIT - III

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, Injection Attacks, SQL Injection, Ransomware, Cross-Site Scripting Attacks, ARP Spoofing Attacks, SYN Floods and detecting SYN Scans, Foot Printing, IP Scanner, Port Scanner, Vulnerability Scanner.

UNIT – IV

Cyber Security: The Legal Perspectives**:** Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Amendments to IT Act, Positive and week areas of IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Data Protection Act 2019.

UNIT – V

Understanding Cyber Forensics: Introduction, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Challenges in Computer Forensics, Cost of Cybercrimes and IPR issues, Software Piracy, Web threats for Organizations, Social media marketing.

Text Books:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. Malcolm McDonald "Web Security for Developers" June 2020, 216 pp. ISBN-13: 9781593279943. No Starch Press.
3. Daniel G. Graham "Ethical Hacking: A Hands-on Introduction to Breaking in"October 2021, 376 pp. ISBN-13: 9781718501874 No Starch Press.
4. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.

Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback – 2018.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge university press, 2006.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
2. https://onlinecourses.swayam2.ac.in/cec20_cs15/preview

23CSE135

BUSINESS ANALYTICS
Elective – V

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The objectives of this course are

1. Understanding the basic concepts of business analytics and applications.
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

Course Outcomes:

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

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO 1	3	2	2	1	1	1	1	-	-
CO 2	3	3	2	1	1	1	-	3	3
CO 3	3	3	3	1	-	1	-	-	-
CO 4	3	3	3	1	1	1	-	-	-
CO 5	3	3	3	1	-	1	-	-	-
CO 6	3	3	3	1	1	1	-	-	-

UNIT - I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DDdecision making and future.

UNIT - II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization.

UNIT - III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT - IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria,Ensemble and method and random forest. Clustering: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, Prescriptive Analytics- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process,cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

Textbooks:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

Suggested Readings:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making",5th Edition, Cengage, 2015.

23MEO101

INDUSTRIAL SAFETY
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aims to
1. Familiarize causes for industrial accidents and preventive steps to be taken.
2. Elucidate fundamental concepts of Maintenance Engineering.
3. Explain about wear and corrosion along with preventive steps to be taken
4. Provide basic concepts and importance of fault tracing.
5. Provide steps involved in carrying out periodic and preventive maintenance of
6. various equipment used in industry

Course Outcomes:
Upon completion of this course, students will be able to:
1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipment's like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipment like motors, pumps and air compressors and machine tools etc.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	3	2	2
CO 2	3	3	3	2	2	3
CO 3	3	1	3	2	1	3
CO 4	3	1	3	2	1	3
CO 5	3	2	3	3	3	3

UNIT - I
Industrial Safety: Accident, Causes, Types, Results and control, Mechanical and electrical hazards, Types, Causes and preventive steps/procedure, Describe salient points of factories act 1948 for health and safety, Wash rooms, Drinking water layouts, Light, Cleanliness, Fire, Guarding, Pressure vessels, Safety color codes, Fire prevention and firefighting, Equipment and methods.

UNIT – II
Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life ofequipment.

UNIT – III
Wear and Corrosion and their Prevention: Wear, Types, Causes, Effects, Wear reduction methods, Lubricants, Types and applications, Lubrication methods, General sketch, Working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing, Concept and importance, Decision tree concept, Need and applications, Sequence of fault finding activities, Show as decision tree, Draw decision tree for problems in machine tools, Hydraulic, Pneumatic, Automotive, Thermal and electrical equipment's like any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V

Periodic and Preventive Maintenance: Periodic inspection, Concept and need, Degreasing, Cleaning and repairing schemes, Overhauling of mechanical components, Overhauling of electrical motor, Common troubles and remedies of electric motor, Repair complexities and its use, Definition, Need, Steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance, Repair cycle concept and importance

Text Books:

1. H. P. Garg, Maintenance Engineering, S. Chand and Company
2. Audels, Pump-hydraulic Compressors, McGraw Hill Publication

Suggested Readings:

1. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
2. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London

23MEO102

INTRODUCTION TO OPTIMIZATION TECHNIQUES

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

Course Outcomes:

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

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	1	3	1	2	2
CO 2	3	1	3	1	2	2
CO 3	1	1	3	2	3	2
CO 4	2	1	3	2	2	3
CO 5	2	1	3	2	2	3

UNIT - I

Operations Research: Definition, scope, Models, Linear programming problems(LPP), Formulation, Graphical Method, and Simplex Method.

UNIT - II

Transportation Models: Finding an initial feasible solution, North West corner method, Least cost method, Vogel's approximation method, Finding the optimal solution, Special cases in transportation problems, Unbalanced transportation problem, Degeneracy in transportation, Profit maximization in transportation.

UNIT- III

Project Management: Definition, Procedure and objectives of project management, Differences between PERT and CPM, Rules for drawing network diagram, Scheduling the activities, Fulkerson's rule, Earliest and latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, Duration of the project, Free float, Independent float and total float

UNIT - IV

Queuing Theory and Inventory:: Kendols notation, Single server models, Inventory control, Deterministic inventory models, Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, Objectives, General assumptions, Processing 'n' jobs through two machines, Processing 'n' jobs through three machines

Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

Suggested Reading:

1. Hitler Libermann, Operations Research, McGraw Hill Pub, 2009
2. Harvey M Wagner, Principles of Operations Research, Prentice Hall of India, 2010

23CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The objectives of this course are

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis.
4. To provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis.
5. To train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes:

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principlesof project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4
CO 1	1	1	-	1
CO 2	1	2	1	1
CO 3	1	1	1	1
CO 4	2	2	1	1
CO 5	-	-	1	1

UNIT - I

Project Management: Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles and responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT - II

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT - III

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT - IV

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement.

UNIT-V

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Charles T Horngren "Cost Accounting A Managerial Emphasis", Pearson Education; 14 edition (2012),
2. Charles T. Horngren and George Foster, "Advanced Management Accounting" Prentice-Hall; 6th Revised edition (1 February 1987)
3. Robert S Kaplan Anthony A. Atkinson, "Management & Cost Accounting" , Pearson; 2 edition (18 October 1996)

Suggested Readings:

1. K. K Chitkara, "Construction Project Management: Planning, scheduling and controlling", Tata McGraw-Hill Education. (2004).
2. Kumar NeerajJha "Construction Project Management Theory and Practice",Pearson Education India; 2 edition (2015)

23MEO103

COMPOSITE MATERIALS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to

1. Provide concepts of Composite materials and their constituents.
2. Explain the Classification of the reinforcements and evaluate the behaviour of composites.
3. Provide Fabrication methods of metal matrix composites.
4. Explain manufacturing of Polymer matrix composites.
5. Elucidate Failure mechanisms in composite materials.

Course Outcome:

At the end of the course, student will be able to

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	1	3	1	1	3
CO 2	3	1	3	1	1	3
CO 3	3	2	3	1	1	3
CO 4	3	2	3	1	1	3
CO 5	3	1	3	1	1	3

UNIT - I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT - II

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behaviorof composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT - III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT - IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepegs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V

Strength: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

Text Books:

1. K.K.Chawla, “Composite Materials- Science and Engineering”, 4th edition, Springer Verlag, 2019.
2. WD Callister, Jr., Adapted by R. Balasubramaniam , “Materials Science and Engineering, An introduction”.

Suggested Readings:

1. Deborah D.L. Chung, “Composite Materials Science and Applications” 2nd edition, Springer Verlag, 2010.
2. Sanjay K. Mazumdar, “Composites Manufacturing- materials, product and process engineering”, 1st edition, CRC press, 2002.
3. Daniel Gay, “Composite Materials Design and Applications” 3rd edition, CRC press, 2015.

23MEO104

ALTERNATIVE ENERGY SOURCES

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of geothermal energy and bio-energy
5. Merits and demerits of tidal energy, wave energy and OTEC

Course Outcomes: At the end of the course, the students are able to

1. Understand the need for renewable energy sources in the context of environmental issues.
2. Apply the principles of solar energy for domestic and industrial usages.
3. Understand the working principle of wind power plants along with merits and demerits.
4. Describe the concepts of geothermal energy sources and biomass as a source of energy.
5. Explain the principles and impact of wave, tidal and OTEC plants on the environment.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	2	3	2	2	1
CO 2	3	2	3	1	1	2
CO 3	3	3	3	1	2	2
CO 4	3	2	3	1	1	2
CO 5	3	2	2	1	2	3

UNIT - I

Energy Sources: Energy characteristics, forms of energy, energy chain (route), energy sectors, Indian energy scenario, energy pricing in India, energy and environment, energy security, energy conservation and its importance, energy strategy for future, classification of energy sources, availability of conventional and non-conventional (renewable) energy sources, classification of RES - solar, wind, geothermal, bio-mass, ocean tidal, ocean wave and ocean thermal energy conversion (OTEC), advantages and limitations of conventional and renewable energy sources.

UNIT - II

Solar Energy: Solar radiation, solar thermal collectors, working of flat plate and concentrating (focusing) solar collectors and their limitations, comparison of flat plate and focusing collectors, applications of solar collectors - water heating, space heating, low temperature power generation, solar cookers, water pumping, SODIS, solar thermal power plant, advantages and limitations of solar energy systems, PV materials, PV cells and their manufacturing, space based solar power (SBSP), solar satellite system, advantages and disadvantages of SBSP.

UNIT - III

Wind Energy: Sources of wind, merits and demerits of wind energy, site selection for wind energy conversion system, wind turbine (wind mill), classification of wind mills, working principle horizontal axis and vertical axis windmills, horizontal vs vertical axis windmills, power extracted from the wind, effect of velocity on power generation, new developments and problems in operating large wind power generators.

UNIT - IV

Geothermal Energy: Layers in earth, resources of geothermal energy, hydrothermal, petrothermal and geopressure resources, advantages, disadvantages, applications and environmental effects of geothermal energy sources.

Biomass Energy: Resources, biogas and its composition, process of biogas generation, wet process and dry process, raw materials available for biogas fermentation, economical, social, environmental and health benefits of biogas utilization, selection of site and constructional techniques of a biogas plant, working of KVIC, Pragathi design, Janata and Deenbandu biogas plants, common operational problems, causes and remedies relating to abiogas plant.

UNIT V

Tidal power: Tidal systems, site selection for tidal power plant, schematic layout of tidal power house, principle ofoperation of single basin and double basin tidal plants, advantages and disadvantages of tidal power.

Wave energy - Differences between tides and waves, advantages and disadvantages of wave power, problemsassociated with wave energy collection, working principle of wave energy conversion devices.

Ocean thermal energy conversion (OTEC) - OTEC power plants, location, open cycle and closed cycle OTECplants, advantages, limitations and applications of OTEC, environmental impact of OTEC plants.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, –Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2017.
2. Dr. R.K. Singal, –Non Conventional Energy Resources‖, S.K. Kataria & Sons, New Delhi, 2005.

Reference books:

1. K. M. Mittal, –Non-Conventional Energy Systems‖, Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Shali Habibulla, –Non-Conventional Energy Sources‖, State Institute of Vocational Education, Hyderabad, 2005.
3. G.D. Rai, –Non Conventional Energy Sources‖, Khanna Publishers, New Delhi, 2011.

23MEO105

COMPUTATIONAL METHODS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

To make the students to learn the

1. Basic equations and concept of CFD.
2. Concept of PDEs and finite difference methods.
3. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods.
4. Various types of grid generation and errors in numerical solution.
5. Importance of FVM.

Course Outcomes:

At the end of the course, student will be able to

1. Derive CFD governing equations and turbulence models.
2. Apply different PDEs and know the importance of Taylor series of expansion.
3. Solve simultaneous linear equations with various methods.
4. Understand errors, stability, consistency and develop O,H and C grid generated models.
5. Utilize FVM for heat transfer problems.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	1	3	1	2	2
CO 2	3	1	3	1	2	2
CO 3	3	1	3	1	2	3
CO 4	3	1	3	1	2	3
CO 5	3	1	3	1	2	3

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference, explicit, Implicit and Crank Nicholson.

UNIT- III

Finite Difference Solutions: Solution of simultaneous linear equations: Jacobi, Gauss Seidel, TDMA, ADI, solution for viscous incompressible flow using Vorticity Stream function method, MAC method.

UNIT - IV

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Staggered grids SIMPLE and SIMPLE R algorithms.

Text Books:

1.P.S. Ghoshdastidar, Computational Fluid Dynamics and Heat Transfer, Cengage, 2017.
2. John D. Anderson, “Computational Fluid Dynamics”, Mc Graw Hill Inc., 2018.
3. H. K. Versteeg and Malala Shekara, “Introduction to Finite Volume Method”, Pearson, 2015.

Suggested Reading:

1.K. Muralidhar and T. Sundararajan T., “Computational Fluid flow and Heat transfer”, Narosa Publishing House, 2003.
2. S.V. Patankar, “Numerical Heat transfer and Fluid flow”, Hemisphere Publishing Company, New York, 1980.

23EEO 101

WASTE TO ENERGY
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
The objectives of this course are
1. To know the various forms of waste.
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

Course outcomes:
Upon completion of this course, students will be able to:
1. Understand the concept of conservation of waste.
2. Identify the different forms of wastage.
3. Chose the best way for conservation to produce energy from waste.
4. Explore the ways and means of combustion of biomass.
5. Develop a healthy environment for the mankind.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	2	2	-
CO 2	-	2	1	2	2	1
CO 3	-	2	1	2	2	1
CO 4	-	-	-	2	2	1
CO 5	-	1	1	2	2	1

UNIT - I
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal –Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT - IV
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

1. "Non-Conventional Energy", Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. "Biogas Technology - A Practical Hand Book" - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Suggested Readings:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

23PYO101

HISTORY OF SCIENCE AND TECHNOLOGY
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The objectives of this course are

1. Gains the knowledge about origin of science in the Stone Age and its progress during Antiquity period.
2. Familiar with scientific views in the Medieval period and during the Industrial revolution.
3. Aware of modern scientific developments from 19th century onwards.

Course Outcomes:

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

1. Demonstrate the process of beginning of science and civilization, knowledge acquisition and philosophical approach of science and its advancements in the Stone Ages and Antiquity period.
2. Illustrate the advancements in science and technology in the medieval period across Asia and Arab countries and decline and revival of science in Europe.
3. Explain the scientific approach and its advances of the Europeans and how the role of engineer during the industrial revolution and the major advancements.
4. Make use of the advancements in the field of science and technology by adopting new philosophies of 19th and first half of 20th century in finding ethical solutions to the societal problems.
5. Interpret the changes in specializations of science and the technology and build the relation between information and society from second half of 20th century onwards.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	1	1	1
CO 2	1	1	1	2	0	1
CO 3	1	1	1	1	1	0
CO 4	1	1	1	1	1	1
CO 5	0	1	2	1	1	1

UNIT - I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions, Civilization ,Major advances. Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, major advances.

UNIT - II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe ,Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances. The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT - III

Scientific Method: Measurement and Communication (1660 AD – 1734): Europeandomination, The scientific method, Major advances. The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

UNIT - IV

Science and Technology in the 19th Century (1820 AD – 1894 AD):philosophical basis of 19th-century science, Science and the public, Science and technology, Major advances. Rise of **Modern Science and Technology (1895AD – 1945 AD):** The growth of 20thcentury science, New philosophies, Quantumreality, Energy sources, Electricity: a revolution in technology, Major advances.

UNIT-V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science,Specialization and changing categories, Technology changes society, Major advances.; **The Information Age (1973 AD – 2015 AD):**Information and society, Globalization, The post-industrial society, Problems of the Information age, Major Advances

Textbooks:

1. Bryan and Alexander Hellemans, "The History of Science and Technology", Houghton Mifflin Company, 2004.
2. JD Bernal, "Science in History", 4 volumes, Kindle Edition.

Suggested Readings:

1. Kara Rogers, "The 100 Most Influential Scientists of All Time", Britannica Educational Publishing, 2010
2. Alberto Hernandez, "A Visual History of Science and Technology", The Rosen Publishing Group, 2016.

23CSC 109

DISSERTATION PHASE-I

Instruction	20 Hours per week
Duration of End examination	-
Semester end examination	-
CIE	100 Marks
Credits	10

Pre-requisites: Research Methodologies and IPR, Basic knowledge of problem solving,

Course Outcomes:

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

1. Inculcate the culture of self-learning on various topics
2. Review literature such as books, journal, technical documents related to problem specific domain
3. Analyze the complex real world problems
4. Formulate the solutions using the appropriate methodology
5. Design and represent solutions using the appropriate design diagrams
6. Develop research culture, communicate with engineers and the community at large in written an oral forms.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	3	3	3	3	3	3	3	-	-
CO2	-	3	-	-	2	-	-	2	-
CO3	-	3	-	3	2	-	3	2	-
CO4	-	3	3	-	-	-	3	-	2
CO5	-	3	-	-	-	-	-	-	2
C06	-	-	3	3		3	2	3	3

Guidelines:

- The dissertation topic shall be a complex real world problem with research potential and should involve scientific research.
- Student shall carry out literature review, gather or generate the required data and analyze data, determine the suitable solution and must preferably bring out the individual contrition.
- Seminar shall be based on the area in which the student has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature reviewed.
- The preliminary results (if available) of the problem along with the design may also be discussed in the report
- The work carried out by the student shall be presented in front of the Committee consisting of Head, Chairman-BoS, Supervisor and Project Coordinator
- Students shall be in regular contact with their supervisor and the topic of dissertation must be mutually decided by the supervisor and the student.

CIE Assessment Guidelines Max Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the topic
	10	PPT Preparation(s)
	10	presentation(s)
	10	Question and Answers
	10	Report preparation

Note: Department committee has to assess the every two weeks.

23CSC 110

DISSERTATION PHASE-II

Instruction	32 Hours per week
Duration of SEE	3
SEE	100 Marks
CIE	100 Marks
Credits	16

Pre-requisites: Research Methodologies and IPR, Basic knowledge of problem solving, Technical Writing

Course Outcomes:

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

1. Use different experimentation techniques and technologies
2. Develop experimental set up/ Environment test rig
3. Conduct experiments by using the benchmark data sets
4. Analyze and interpret the results by using appropriate modern tools
5. Communicate effectively with technical reports and oral presentation
6. Make research contributions by publishing their work to the research community

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PEO1	PEO2	PEO3
CO1	-	-	3	3	-	-	3	-	-
CO2	2	3	3	-	-	-	3	-	2
CO3	-	3	-	-	-	-	2	-	2
CO4	-	3	3	-	-	-	3	-	-
CO5	-	-	-	-	3	-	3	-	2
C06	-	-	-	3	3	2	-	-	3

Guidelines:

- It is a continuation of Project work started in semester III-Semester.
- Students have to submit the report in a prescribed format and also present a seminars
- The dissertation work shall be presented in a standard format as provided by the department.
- Students have to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology experimental set up or numerical details as the case may be) of solution and results and discussions.
- The report must also bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD, and BoS Chairperson), and supervisor/Co T Supervisor.
- Students should be in regular contact with their supervisor/Co-Supervisor.

CIE Assessment Guidelines		**Max Marks: 100**
Evaluation by	**Max. Marks**	**Evaluation Criteria**
Supervisor	05	Review-1
	10	Review-2
	10	Review-3
	15	Final presentation with the draft copy of the report in a standard format
	10	Submission of the report
Department Committee	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of work which may lead to publication
	10	Analytical Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

SEE Assessment Guidelines		Max Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria**
Supervisor	20	Power Point Presentation
	40	Quality of dissertation report and Evaluation
Department Committee	20	Quality of the Dissertation: • Innovations • Applications • Live Research work • Scope for future study • Application to Society • Regularity and Punctuality
	20	Viva-Voce

Note: Department Committee shall assess the progress of the student for every TWO weeks.