GOKUL GLOBAL UNIVERSITY

विद्या अनन्तम्

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

# COURSE STRUCTURE

## Master of Engineering

## Computer Engineering

# Under

# Choice Based Credit System (CBCS)

Faculty of Engineeering
Hansaba College of Engineering & Technology
University Campus, State Highway-41, Siddhpur - 384151, Dist. Patan, Gujarat, INDIA
E: dean.fac.engg@gokuluniversity.ac.in W: www.gokuluniversity.ac.in M: +91 95109 73860

# PROGRAM OUTCOMES (PO)

PO1. An ability to independently carry out research /investigation and development work to solve practical problems [Problem Solving and Research Skill]

PO2. An ability to write and present a substantial technical report/document [Communication]

PO3. 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 [Lifelong Learning]

PO4. An ability to apply advanced knowledge and skills appropriate to the discipline. [Scholarship of knowledge]

PO5. An ability to think critically and apply appropriate logic, analysis, judgment and decision making and to function as an effective member or leader of engineering teams to achieve common goals. [Collaborative and Multidisciplinary work]

PO6. An ability to use appropriate techniques, skills, and modern engineering tools necessary for engineering practice and commit to professional ethics and responsibilities [Usage of Modern Tools , Ethical Practices and Social Responsibility]

## Program Specific Outcomes (PSO's)

PSO1 Develop software applications/solutions as per the needs of Industry and society

PSO2 Adopt new and fast emerging technologies in computer science and engineering.

| SR | SEMESTER | SUBJECT CODE | SUBJECT NAME | CREDIT | CATEGORY |
|---|---|---|---|---|---|
| 1 | I | FEM115401 | Mathematical Foundation of Computer Science | 4 (3+0+2) | Program Core |
| 2 | I | FEM215402 | Advanced Data Structure | 4 (3+0+2) | Program Core |
| 3 | I | - | Major Elective - I | 4 (3+0+2) | Program Elective |
| 4 | I | - | Major Elective - II | 4 (3+0+2) | Program Elective |
| 5 | I | FEM110001 | Research Skill & Methodology | 2 (1+0+2) | Research |
| 6 | I | FEM110002 | Disaster Management | 0 (2+0+0) | Audit |
| **TOTAL** | | | | **18** | |

| **Major Elective I** | |
|---|---|
| FEM115403 | Distributed System |
| FEM115404 | Data Science |
| FEM115405 | Data Preparation & Analysis |
| **Major Elective II** | |
| FEM115406 | Machine Learning |
| FEM115407 | Wireless Sensor Network |
| FEM115408 | Advanced Wireless & Mobile Networks |

| SR | SEMESTER | SUBJECT CODE | SUBJECT NAME | CREDIT | CATEGORY |
|---|---|---|---|---|---|
| 1 | II | FEM225401 | Advanced Algorithm | 4 (3+0+2) | Program Core |
| 2 | II | FEM125402 | Image Processing | 4 (3+0+2) | Program Core |
| 3 | II | - | Major Elective – III | 4 (3+0+2) | Program Elective |
| 4 | II | - | Major Elective - IV | 4 (3+0+2) | Program Elective |
| 5 | II | FEM125409 | Mini Project with Seminar | 2 (0+0+4) | Research |
| 6 | II | FEM120001 | Research Paper Writing | 0 (2+0+0) | Audit |
| **TOTAL** | | | | **18** | |

| **Major Elective III** | |
|---|---|
| FEM125403 | Soft Computing |
| FEM125404 | Data Mining and Data Warehousing |
| FEM125405 | Embedded System |
| **Major Elective IV** | |
| FEM125406 | Service Oriented Architecture |
| FEM125407 | Global Information & Positioning System |
| FEM125408 | Real Time Operating System |

| SR | SEMESTER | SUBJECT CODE | SUBJECT NAME | CREDIT | CATEGORY |
|---|---|---|---|---|---|
| 1. | III | - | Major Elective - V | 3 (2+0+2) | Program Elective |
| 2. | III | - | Open Elective - I | 3 (3+0+0) | Open Elective |
| 3. | III | FEM135407 | Internal Review - I | 2 (0+0+4) | Research |
| 4. | III | FEM135408 | Dissertation Phase - I | 8 (0+0+16) | Research |
| **TOTAL** | | | | | **16** |

| **Major Elective V** | |
|---|---|
| FEM135401 | Mobile Application & Services |
| FEM135402 | Cloud Computing |
| FEM135403 | Deep Learning |
| **Open Elective I** | |
| FEM135404 | Semantic Web |
| FEM135405 | Business Analytics |
| FEM135406 | Operation Research |

| SR | SEMESTER | SUBJECT CODE | SUBJECT NAME | CREDIT | CATEGORY |
|---|---|---|---|---|---|
| 1 | IV | FEM145401 | Internal Review - II | 2 (0+0+4) | Research |
| 2 | IV | FEM145402 | Dissertation Phase- II | 14 (0+0+28) | Research |
| **TOTAL** | | | | | **16** |

FEM115401: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

**Objective:** The course intends to provide mathematical foundations to graduate students. The course should enhance their ability to develop mathematical models and solve problems using analytical and numerical methods.

**Credit: 4** **Semesters I** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | 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 | **7** | **15%** |
| 2 | Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood | **7** | **15%** |
| 3 | Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment | **8** | **16%** |
| 4 | Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems | **11** | **23%** |
| 5 | Computer science and engineering applications: Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, | **16** | **34%** |

| | | | |
|---|---|---|---|
| | distributed systems, Bioinformatics, Machine learning<br>Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision | | |

**References Books: -**

1. John Vince, Foundation Mathematics for Computer Science, Springer
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis
4. Alan Tucker, Applied Combinatorics, Wiley

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

**CO-1:** Ability to apply mathematical logic to solve problems.

**CO-2:** Understand sets, relations, functions and discrete structures.

**CO-3:** Able to use logical notations to define and reason about fundamental mathematical concepts such as sets relations and functions.

**CO-4:** Able to formulate problems and solve recurrence relations.

**CO-5:** Able to model and solve real world problems using graphs and trees

| **Course Outcomes** | **Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **CO-1** | 1 | 2 | 1 | - | - | - | - | - | - | - | - | - | 1 | - |
| **CO-2** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 2 |
| **CO-3** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO-4** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-5** | 1 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |

FEM215402: ADVANCED DATA STRUCTURE

**Objective:** The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.

Students should be able to understand the necessary mathematical abstraction to solve problems.

To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.

Student should be able to come up with analysis of efficiency and proofs of correctness.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Dictionaries:**<br>Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.<br>**Hashing:**<br>Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing. | 07 | 15% |
| 2 | **Skip Lists:**<br>Need for Randomizing Data Structures and Algorithms, Search and | 05 | 10% |

| | | | |
|---|---|---|---|
| | Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists | | |
| **3** | **Trees:**<br>Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees | **09** | **15%** |
| **4** | **Text Processing:**<br>Sting Operations, Brute-Force Pattern Matching, The BoyerMoore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem. | **12** | **25%** |
| **5** | **Computational Geometry:**<br>One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.<br>**Recent Trends in Hashing**<br>Trees, and various computational geometry methods for efficiently solving the new evolving problem | **15** | **35%** |

**Reference Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004. 2.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

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

**CO-1:** Understand the implementation of symbol table using hashing techniques.
**CO-2:** Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
**CO-3:** Develop algorithms for text processing applications.

**CO-4:** Identify suitable data structures and develop algorithms for computational geometry problems.
**CO-5:** Basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
**CO-6:** Ability to apply and implement learned algorithm design techniques and data structures to solve problems.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | - |
| CO-2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| CO-3 | - | 3 | 1 | 1 | - | - | - | - | - | - | - | 2 | 1 | - |
| CO-4 | - | 3 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | - |
| CO-5 | 1 | 3 | 1 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |

**List of Experiment:**

1. Write Java programs that use both recursive and non-recursive functions for implementing the following searching methods: a) Linear search b) Binary search
2. 2 Write Java programs to implement the following using arrays and linked lists
3. 3 Write Java programs to implement the following using an array. a) Stack ADT b) Queue ADT
4. 4 Write a Java program that reads an infix expression and converts the expression to postfix form.
5. (Use stack ADT).
6. 5 Write a Java program that uses both a stack and a queue to test whether the given string is a palindrome or not.
7. 6 Write Java programs to implement the following using a singly linked list. a) Stack ADT b) Queue ADT
8. 7 Write a Java program to perform the following operations:
    a. Construct a binary search tree of elements.
    b. Search for a key element in the above binary search tree.
    c. Delete an element from the above binary search tree.
9. 8 Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.

10. 9 Write Java programs that use recursive and non-recursive functions to traverse the given binary tree in a)Preorder b) Inorder c) Postorder
11. 10 Write Java programs for the implementation of bfs and dfs for a given graph.
12. Write Java programs for implementing the following sorting methods: a) Bubble sort b) Insertion sort c) Quick sort d) Merge sort e) Heap sort f) Radix sort g) Binary tree sort
13. 12 Write a Java program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree

FEM115404: DATA SCIENCE

**Objective:** Provide you with the knowledge and expertise to become a proficient data scientist.

- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
- Produce Python code to statistically analysis a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to core concepts and technologies:** Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications. | 06 | 10% |
| 2 | **Data collection and management:** Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources | 07 | 15% |
| 3 | **Data analysis:** Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes. | 10 | 30% |

| | | | |
|---|---|---|---|
| **4** | **Data visualization:**<br>Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings. | **11** | **20%** |
| **5** | **Applications of Data Science:**<br>Technologies for visualisation, Bokeh (Python)<br>**Recent trends in various data collection and analysis techniques:** various visualization techniques, application development methods of used in data science. | **14** | **25%** |

**Reference Books:**

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

**Course Outcome:**

After learning the course the students should be able to:

1. Explain how data is collected, managed and stored for data science;
2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
3. Implement data collection and management scripts using MongoDB.

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

**CO-1:** Understand fundamental algorithmic ideas to process data
**CO-2:** Identify and apply various machine learning models
**CO-3:** Demonstrate and understand role of R programming in data science
**CO-4:** Apply the knowledge of python based data visualization
**CO-5:** Understand Map Reduce framework and HDFS in Hadoop
**CO-6:** Demonstrate various documentation techniques

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **CO-1** | 2 | 2 | - | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO-2** | 2 | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| **CO-3** | - | - | 2 | - | 3 | - | - | - | - | - | - | - | - | - |
| **CO-4** | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| **CO-5** | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-6** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |

**List of Experiments:**

1. Building chatbots.
2. Credit card fraud detection.
3. Fake news detection.
4. Forest fire prediction.
5. Classifying breast cancer.
6. Driver drowsiness detection.
7. Recommender systems.
8. Sentiment analysis.
9. Exploratory data analysis.
10. Gender detection and age detection.
11. Recognizing speech emotion.
12. Customer segmentation.

FEM115406: MACHINE LEARNING

**Objective:** Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. This subject will help students to learn patterns and concepts from data without being explicitly programmed in various IOT nodes and also motivates them to design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1. | Introduction Learning Problems, designing a learning system, Issues with machine learning. Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias | 07 | 11% |
| 2. | Supervised and Unsupervised learning Decision Tree Representation, Appropriate problems for Decision tree learning, Algorithm, Hypothesis space search in Decision tree learning, inductive bias in Decision tree learning, Issues in Decision tree learning K- Nearest Neighbor Learning Locally Weighted Regression, Radial Bases, Functions, Case Based Reasoning | 11 | 25% |
| 3. | Artificial Neural networks and genetic algorithms Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptions, Multilayer Networks and Back Propagation Algorithms, Remarks on Back Propagation Algorithms Case Study: face Recognition | 11 | 25% |

| | | | |
|---|---|---|---|
| **4.** | Bayesian Learning Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and Least squared Error Hypothesis, Maximum likelihood hypothesis for Predicting probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm Case Study: Learning to classify text, | **11** | **25%** |
| **5.** | Overview of typical application areas, such as Recommender System, etc | **10** | **14%** |

**Reference Book**

1. Henrik Brink, Joseph Richards, Mark Fetherolf, "Real-World Machine Learning", DreamTech
2. Christopher Bishop, "Pattern Recognition and Machine Learning"
3. Hastie, Tibshirani, and Friedman, "Elements of Statistical Learning". Springer.
4. Jiawei Han and Michelline Kamber, "Data Mining: Tools and Techniques", 3rd Edition
5. I H Witten, Eibe Frank, Mark A Hall, "Data Mining: A practical Machine Learning Tools and techniques", Elsevier
6. Couresera.org: Machine Learning by Andrew Ng, Stanford University
7. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012.
8. Machine Learning for Big Data, Jason Bell, Wiley
9. Machine Learning in Python, Michael Bowles, Wiley

**Text Book:**

1. Tom M Mitchell, "Machine Learning", McGraw Hill
2. Peter Harrington, "Machine Learning in Action", DreamTech

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

**CO-1:** Identify the different machine learning approaches for supervised learning
**CO-2:** Analyze the different dimensionality reduction techniques available
**CO-3:** Identify the different classifier models suitable for machine learning
**CO-4:** Examine different approaches for training neural network and decision tree learning
**CO-5:** Enumerate the working of classifier models like Support Vector Machine and Hidden Markov Models
**CO-6:** Identify and apply different clustering algorithms in real life problems

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 3 | 1 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 3 | 3 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| CO-3 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 3 |
| CO-4 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 3 |
| CO-5 | 3 | 1 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 3 |
| CO-6 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 3 |

**List of Suggested Practical:**

Suggestions for Lab Sessions Practical's to implement following ten algorithms, using Python

1. Classifying with distance measures,
2. Constructing Decision trees and Classification using Decision Trees
3. K-means
4. Classification with k-Nearest Neighbors,
5. Random Forest
6. Support vector machines
7. Expectation Maximization,
8. PageRank,
9. AdaBoost,
10. Naïve Bayes Classification
11. CART.

Few Examples which apply above algorithms:

1. Improving a handwriting recognition system
2. Using decision trees to predict contact lens type
3. Classifying text
4. Classifying spam mail with naïve Bayes
5. Using naïve bayes to reveal local attitudes from personal ads

FEM110001: RESEARCH SKILL & METHODOLOGY

**Objective:** The students should get familiar with the Research Skill and its Methodology.

**Credit: 2** **L-T-P: 0-1-2**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 0 | 1 | 2 | 3 | 2 | 00 | 00 | 50 | 50 | 100 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to Research:** Nature and Scope of Research, Information Based Decision Making and Source of Knowledge. The Research Process, Basic approaches and Terminologies used in Research, Defining Research Problem and Framing Hypothesis, Preparing a Research Plan | 6 | 12% |
| 2 | **Defining the Research Problem and Research Design** What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Meaning of Research Design, Need for Research Design, Future of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Basic Principals of Experimental Designs | 7 | 19% |
| 3 | **Sampling Design** Census and sample survey, Implications of a Sample Design, Steps in sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of sample Designs, How to Select a Random Sample?, Random Sample from an Infinite Universe, Complex Random Sampling Designs **Methods of Data Collection** | 14 | 34% |

| | | | |
|---|---|---|---|
| | Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection | | |
| **4** | **Data Analysis**<br>Data Analysis and Presentation Editing and coding of data, tabulation, graphic presentation of data, cross tabulation, Testing of hypotheses; Parametric and nonparametric tests for Uni variant and Bi variant data. Tests of association; simple linear regression and other non-parametric tests, Sampling techniques, Probability, Probability Distributions, Hypothesis Testing, Level of Significance and Confidence Interval, t-test, ANOVA, Correlation, Regression Analysis<br>**Interpretation of Data and Paper Writing**<br>Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. | **11** | **22%** |
| **5** | **Report Writing**<br>Significance of Report Writing, Deferent Steps in Writing Report. Layout of the Research Report, Types of Report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing a Research Report<br>**Patent Rights**<br>Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications | **4** | **13%** |

**Reference Books:**

1. Research Methodology Methods and Techniques by C. R. Kothari, New Age International Publishers.
2. Research Methodology by D. K. Bhattacharyya, Excel Books Publications.

3. Research Methodology: A Guide for Researchers in Management and Social Sciences by Taylor, Sinha & Ghoshal, PHI Publications

**Course outcome**

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

CO-1: Conduct a quality literature review and find the research gap.
CO-2: Identify an original and relevant problem and identify methods to find its solution.
CO-3: Validate the model
CO-4: Present and defend the solution obtained in an effective manner in written or spoken form
CO-5: Take up and implement a research project/ study.

| **Course Outcomes** | **Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **CO-1** | - | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 |
| **CO-2** | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | 3 |
| **CO-3** | - | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 |
| **CO-4** | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | 3 |
| **CO-5** | - | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 |

FEM110002: DISASTER MANAGEMENT

**Objective:** The students should get familiar with the Disaster and its challenges.

**Credit: 2** **L-T-P: 2-0-0**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 2 | 0 | 0 | 2 | 0 | 70 | 30 | 00 | 00 | 100 |

| Sr | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1. | **Introduction:** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. | 4 | 17 |
| 2. | **Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts | 4 | 17 |
| 3. | **Disaster Prone Areas In India:** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics | 4 | 17 |
| 4. | **Disaster Preparedness And Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness | 4 | 17 |
| 5. | **Risk Assessment:** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for | 8 | 32 |

| | | | |
|---|---|---|---|
| | Survival. | | |

**References Books :**

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

**Course Outcomes :**

After completion of the course, the students will be able to:
**CO-1:** Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
**CO-2:** Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
**CO-3:** Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations..
**CO-4:** Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.
**CO-5:** Understand impact of Disasters and realization of societal responsibilities.
**CO-6:** Apply Disaster management principles.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO-2 | 1 | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| CO-3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO-4 | - | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - |
| CO-5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO-6 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |

List of Suggested Tutorials:

1. Difference between an experiment and survey.
2. Problems faced by researchers.
3. A research scholar has to work as a judge and derive the truth and not as a pleader who is only eager to prove his case in favour of his plaintiff. Justify the statement.
4. Examine the significance of research.
5. Research is much concerned with proper fact finding, analysis and evaluation. Do you agree? Support your answer.
6. Issues to be attended by researchers in formulating research problem.
7. Develop a research plan.
8. Different ways of sampling.
9. Merits and demerits of different data collection methods.
10. Interpretation is a fundamental component of research process. Justify the statement.
11. Layout of research report.

FEM225401: ADVANCED ALGORITHM

**Objective:** Data structure and algorithm (primitive, nonprimitive, linear data structure (stack, queue, linked list, nonlinear data structure (tree,graph), hashing, File structure) Rationale: Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand and analyze efficient algorithms for various applications.

**Credit: 4** **Semester II** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | Total Marks |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | From problems to programs, set theory, functions and relations Insertion sort, analyzing algorithms, designing algorithms, asymptotic notation. Divide and conquer, Strassen's algorithm for matrix multiplication, The substitution method for solving recurrences, The recursion tree method for solving recurrences, master method | 9 | 20% |
| 2 | Dynamic programming, Making Change, The principal of optimality, the knapsack problem, Floyd's algorithm for shortest Paths Greedy Algorithms, making change, Knapsack problem, Shortest | 9 | 20% |
| 3 | Amortized analysis- aggregate analysis, accounting method, potential method Single source shortest paths. Bellman Ford, directed acyclic graphs, Floyd Warshall algorithm | 9 | 20% |

| | | | |
|---|---|---|---|
| **4** | Number theoretic algorithms, Greatest common dividor, Modular Arithmetic<br>String matching, the naïve string matching, Rabin Karp algorithm, Boyer Moore pattern matching, Knuth Moriss Pratt algorithm | **12** | **20%** |
| **5** | Introduction to NP completeness, The class P and NP, polynomial reductions, NP complete problems<br>Heuristic algorithm – the travelling salesperson, approximate algorithms-knapsack problem | **10** | **20%** |

**Reference Books:**

1. Introduction to Algorithms. Thomas Cormen, Charles Leiserson, Ronald Rivest,Clifford Stein. PHI publication
2. Fundamentals of Algorithms. Gilles Brassard,Paul Bratley. PHI publication
3. Advanced data structure. Peter Brass. Cambridge University Press.
4. Data structures and Algorithms, Allfred Aho, Jeffrey Ullman, John Hopcroft. Pearson Education.
5. Data Structures and Algorithms by G.A.V. Pai, 2009, TMH.
6. Fundamentals of Computer Algorithms by Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, 2nd edition, University Press.
7. Classic Data Structures by D. Samanta, 2005, PHI
8. Design and Analysis of Computer Algorithms by Aho, Hopcraft, Ullman 1998, PEA.
9. Introduction to the Design and Analysis of Algorithms by Goodman, Hedetniemi, TMG.
10. Design and Analysis of Algorithms by E. Horowitz, S. Sahani, 3rd Edition, Galgotia.
11. Data Structures and Algorithms in C++ by Drozdek 2nd Edition, Thomson

**Course Outcome:**

After learning the course the students should be able to:

CO1: Formulate and analyse the algorithms and respective complexities

CO2 : Demonstrate a familiarity with major algorithms and data structures..

CO3 : Analyse and Implement the examples of different types of problems..

CO4 : Categorization of problems on the basis of implementation..

CO5: Synthesize efficient algorithms in common engineering design situations..

CO6 : Redefine the existing algorithm to improve the efficiency.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **CO-1** | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO-2** | 1 | - | - | 2 | - | - | - | - | - | - | - | - | 3 | - |
| **CO-3** | 3 | - | - | 2 | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO-4** | - | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO-5** | 3 | - | - | 3 | - | - | - | - | - | - | - | - | 2 | - |
| **CO-6** | - | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | - |

**List of Suggested Practical:**

1. List the factors that may influence the space complexity of a program. Write a recursive and non recursive function to compute n! Compare the space requirements of nonrecursive function with those of recursive version.
2. The array a[0:9]=[4,2,6,7,1,0,9.8.5.3] is to be sorted using insertion sort. Show the best case, average case and worst case analysis.
3. Write a program to determine whether or not a character string has an unmatched parenthesis. Use a stack. What is the time complexity of your program? Can we replace the stack with a queue?
4. Write a program that implements change making solution. Assume that the cashier has currency notes in the denominations Rs. 100, Rs. 50, Rs. 20, Rs. 10, Rs. 5 and Rs. 1 in addition to coins. Program should include a method to input the purchase amount and the amount given by the customer as well as method to output the amount of change and a breakdown by denomination. Apply greedy algorithm at the cahier side that is give less number of coins if sufficient currency of that denomination available.
5. Write a program for 0/1 knapsack problem using this heuristic: Pack the knapsack in non increasing order of profit density.

6. Write a program that implement divide and conquer method to find the maximum and minimum of n elements. Use recursion to implement the divide and conquer scheme.
7. Implement the Rabin – Karp matcher and Boyer Moore string matching algorithm. Give analysis – For pattern matching in FIREWALL which algorithm is best suited?
8. Implement Bellman ford algorithm. Find an application that can best be solved by Bellman Ford algorithm.
9. Implement Dijkstra's algorithm. Find an application that can best be solved by Dijkstra's algorithm.
10. Consider the subnetting in router. How a source node must be sending a packet to destination node. Does it use greedy, divide and conquer or dynamic programming? Perform analysis.
11. Consider your E-mail account. What data structure can be used to make the search faster if we want subject wise or sender wise search.

FEM125402: IMAGE PROCESSING

**Objective:** This course will provide students with more techniques in the digital image processing for image enhancement as well as restoration of noisy images. Emphasis is given more on implementation of various algorithms so that students will able to develop their own algorithm. The techniques covered in the syllabus have wide applicability in any field which needs to handle the image data.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Digital Image Fundamentals:**<br>Light and Electromagnetic spectrum, Components of Image processing system, Image formation and digitization concepts, Neighbors of pixel adjacency connectivity, regions and boundaries, Distance measures, Applications. | 06 | 15% |
| 2 | **Image Enhancements:**<br>In spatial domain: Basic gray level transformations, Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters.<br>In Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters, Sharpening frequency domain filters. | 12 | 25% |
| 3 | **Image Restoration:**<br>Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, | 10 | 25% |

| | | | |
|---|---|---|---|
| | Estimating the degradation function, Inverse filtering.<br>**Color Image Processing:**<br>Color fundamentals, Color models, Color transformation, Smoothing and Sharpening, Color segmentation. | | |
| **4** | **Wavelet and Multi-resolution Processing:**<br>Image pyramids, Multi-resolution expansion, wavelet transform.<br>**Image Compression:**<br>Introduction, Image compression model, Error-free compression, Lossy compression. | **09** | **15%** |
| **5** | **Morphological Image Processing:**<br>Preliminaries, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation, Basic morphological algorithms for boundary extraction, Region filling, extraction of connected components, thinning and thickening.<br>**Image Segmentation:**<br>Detection of discontinuities, Edge linking and boundary detection, thresholding. | **11** | **20%** |

**Reference Books:**

1. Digital Image Processing, by Rafel C. Gonzalez and Richard E. Woods, Pearson Education, latest edition.
2. Digital Image Processing by Bhabatosh Chanda and Dwijesh Majumder, PHI
3. Fundamentals of Digital Image Processing by Anil K Jain, PHI
4. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson Education

**Course Outcome:**

After learning the course the students should be able to:

CO1: Students will be able to compare different methods for image acquisition, storage and representation in digital devices and computers.

CO2: Students will be able to appreciate role of image transforms in representing, highlighting, and modifying image features.

CO3: Students will be able to interpret the mathematical principles in digital image enhancement and apply them in spatial domain and frequency domain

CO4: Students will be able to apply various methods for segmenting image and identifying image components.

CO5: Students will be able to summarise different reshaping operations on the image and their practical applications.

CO6: Students will be able to identify image representation techniques that enable encoding and decoding images.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| CO-2 | 2 | - | - | 2 | - | - | - | - | - | - | - | - | 2 | - |
| CO-3 | - | - | - | 2 | - | - | - | - | - | - | - | - | 1 | - |
| CO-4 | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| CO-5 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO-6 | 2 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - |

**List of Practical:**

- ✓ Experiments will be based on the topics taught in the theory.

FEM125404: DATA MINING AND DATA WAREHOUSING

**Objective:** The students should get familiar with the Data Mining Concept and Data Warehousing Concept.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to Data Mining**<br>Importance of Data Mining, Data Mining Functionalities, Classification of Data mining systems, Data mining Architecture, Major Issues in Data Mining, Applications of Data Mining, Social impacts of data mining. | 08 | 20% |
| 2 | **Data Pre-processing & Data Mining primitives**<br>Data Pre-processing, Data cleaning, Data Integration and Transformation, Data reduction, Discretization and Concept Hierarchy Generation. Data Mining primitives, Languages and System Architectures, Concept Description: characterization and Comparison, Analytical Characterization, Mining Class Comparison. | 12 | 20% |
| 3 | **Association Rules & Mining Association**<br>Rule Mining, Mining of Single dimensional Boolean association rules, Multilevel association rules and Multidimensional | 06 | 10% |

| | | | |
|---|---|---|---|
| | association rules, Correlation analysis, Constraint based association Mining. | | |
| **4** | **Classification and Predication:** Basic issues regarding classification and predication, Classification by Decision Tree, Bayesian classification, classification by back propagation, Associative classification, Prediction, Classifier accuracy. | **08** | **20%** |
| **5** | **Cluster Analysis** Cluster Analysis, basic issues, clustering using partitioning methods, Hierarchical methods, Density based methods, Grid based methods and model based methods, Algorithms for outlier analysis. **Mining complex Types of data:** Multidimensional analysis and descriptive mining of complex data objects, Introduction to spatial mining, multimedia mining, temporal mining, text mining and web mining with related algorithms. | **16** | **30%** |

**Reference Books:**

1. Data Mining concepts and Techniques by Jiawei Han, Micheline Kamber –Elsevier.
2. Data Mining by Arun K. Pujari – University Press.
3. Mordern Data Warehousing, Data Mining and Visualization by George M.Marakas – Pearson.
4. Data Mining by Vikram Puri And P.RadhaKrishana –Oxfrod Press.
5. Data Warehousing by Reema Theraja –Oxford Press

**Course Outcome:**

After learning the course the students should be able to:

CO1: Understand the data Warehouses, Operational Data Stores (ODS) and OLAP characteristics..

CO2 : Understand the data mining concept, application and their usag.

CO3 : Analyze the frequent patterns using association analysis algorithms like apriori, FP-growth etc..

CO4 : Understand the concept of classification, different classification algorithms and their applications.

CO5: Understand the concept of clustering and different cluster analysis methods.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO-2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO-3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO-4 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO-5 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 | - |

**List of Suggested Practical:**

1. Software Forensic tools such as XML Miner &WeKA.
2. Implementation of data mining algorithm such as Clustering, Classification and Association Rules.
3. OLAP in standard SQL Server.
4. MS Excel & Data mining plug in.

FEM125406: SERVICE ORIENTED ARCHITECTURE

**Objective:** Fundamental for Service Oriented Architecture this course concentrates on delivering the necessary concepts and features.

**Credit: 4** **L-T-P: 3-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction:**<br>Fundamental SOA, Characteristics of contemporary SOA, Misperception about SOA, Tangible benefits of SOA, An SOA timeline, Continuing evolution of SOA, Roots of SOA Service-orientation and object-orientation, SOA Standards Stack, SOA with Web Services, Key Principles of SOA | 10 | 22% |
| 2 | **Enterprise architectures –**<br>Integration versus interoperation , J2EE ,.NET, Model Driven Architecture , Concepts of Distributed Computing, XML | 08 | 11% |
| 3 | **Basic concepts –**<br>Web services framework, Services (Web services: Definition, Architecture and standards), Service descriptions with WSDL, Messaging with SOAP, UDDI | 10 | 15% |

| | | | |
|---|---|---|---|
| **4** | **Principles of Service-Oriented Architecture-**<br><br>WS-* Specifications:<br><br>Message Exchange Pattern, Coordination, Atomic Transactions, BusinessActivities,Orchestration,Choreography,WS-Addressing,WS-ReliableMessaging,WS-Policy (including WS-Policy Attachments and WS-PolicyAssertions),WS-Metadata Exchange, WS-Security (including XML-Encryption, XML-Signature, and SAML), | **10** | **30%** |
| **5** | **Principles of Service-Oriented Computing-**<br><br>RPC versus Document Orientation, Service Life Cycle, Service Creation ,Service Design and Build, Service Deployment, Publish Web service using UDDI, Service Discovery ,Service Selection ,Service Composition ,Service Execution and Monitoring, Service Termination ,Service Composition and Modeling , Orchestration and Choreography, Apache ODE , Business Processes with Business Process Execution Language (BPEL) | **10** | **22%** |

**Reference Books:**

1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", Pearson education.
2. Mark D Hansen, "SOA using Java™ Web Services", Prentice Hall Publication.
3. Muninder Singh & Michael Huhns, "Service Oriented Computing", Wiley
4. Michael Rosen & et el., "Applied SOA", Wiley Publication.
5. Rosheta "SOA based Enterprise Integration", TMH Publication

**Course Outcome:**

After learning the course the students should be able to:

CO1 Understand the concepts of Service Oriented Architecture along with the evolution of SOA

CO2 Understand primary concepts of SOA

CO3 Know the integration of SOA technological points with Web Services.
CO4 Implementation of SOA in development cycle of Web Services.
CO5 Integrate SOA technologies with Web Services paradigms.
CO6 Can learn the reference model of Service Oriented base line backend design for Cloud environment.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 2 | - | - | 1 | - | 2 | - | - | 2 | - | 2 | - | 2 | - |
| CO-2 | - | - | - | - | - | - | 1 | - | - | - | - | - | 2 | - |
| CO-3 | - | 3 | - | - | - | 1 | - | 2 | - | - | 1 | - | 2 | 3 |
| CO-4 | - | - | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| CO-5 | - | - | - | - | - | - | - | - | - | 2 | - | - | 2 | - |
| 2CO-6 | 2 | - | - | 2 | - | 1 | - | - | - | - | 2 | - | 2 | - |

**List of Suggested Practical:**

1. Develop DTD and XSD for University Information System having Exam Enrollment from beginning of Semester, along with Exam Registration and Marks submission by Teachers to University from Various Colleges and Results Sheets Generation by University on Online Report
2. Develop Mark sheet XML Document and display Mark sheet based on CSS and XSL presentation Format
3. Develop Java Based Program using JAXP or XML API in reading XML file for Students Information and Display HTML Table
4. Develop Java Based web Service using REST and SOAP Based web service in Netbeans for University Course List and Search Course based Course Title and Course ID
5. Create DTD file for student information and create a valid well-formed XML document to store student information against this DTD file.

6. Create XMS schema file for student information and create a valid well-formed XML document to store student information against this DTD file.
7. Create web calculator service in . NET Beans and create Java client to consume this web service.
8. Develop same web service using JX-WS
9. Create web calculator service in .NET and Pr. 9 Create java client to consume web service developed using Apache AXIS.
10. Using WS –GEN and WS-Import develop the java web service & call it by Java Client.

FEM125409: MINI PROJECT WITH SEMINAR

**Objective: Research**

**Credit: 2** **L-T-P: 0-0-4**

Teaching & Evaluation Scheme:-

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 0 | 0 | 4 | 4 | 2 | 00 | 00 | 00 | 100 | 100 |

| Content |
|---|
| A mini project requires comparatively less time than major projects. They are comparatively simpler and have shorter duration. Mini Project helps students to explore and strengthen the understanding of fundamentals through practical application of theoretical concepts. Mini Project can help them to boost their skills and widen their horizon of thinking. It will act like beginners guide to undertake the major project/dissertation during the final year and will ensure preparedness of students to undertake major projects/dissertation. Students will be required to select the topic relevant to their specialization and that has value addition. Students will get an opportunity to work in actual industrial environment if they opt for internship. Based on the selected topic student will also prepare seminar report based on the literature survey Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee. |

**Course Outcome:**

After learning the course the students should be able to:

CO1: Demonstrate a sound technical knowledge of their selected mini project topic.

CO2 : Undertake problem identification, formulation and solution..

CO3 : Design engineering solutions to complex problems utilising a systems approach.

CO4 : Communicate with engineers and the community at large.

CO5: Demonstrate the knowledge, skills and attitudes of a professional engineer.

| **Course Outcomes** | **Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **CO-1** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-2** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-3** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-4** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-5** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO-6** | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

FEM120001: RESEARCH PAPER WRITING

**Objective:** The students should get familiar with the Research Paper Writing.

**Credit: 0** **L-T-P: 2-0-0**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 2 | 0 | 0 | 2 | 0 | 70 | 30 | 0 | 0 | 100 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1. | Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness | 4 | 17 |
| 2. | Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction | 4 | 17 |
| 3. | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check | 4 | 17 |
| 4. | Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature | 4 | 17 |
| 5. | Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions<br>Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission | 8 | 32 |

**Reference Books:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**Course Outcome:**

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

CO 1 Understand that how to improve your writing skills and level of readability.
CO 2 Learn about what to write in each section.
CO 3 Understand the skills needed when writing a Title.
CO 4 Ensure the good quality of paper at very first-time submission
CO 5 Relate the quantum concepts in electron microscopes
CO 6 Describe the unit cell characteristics and the growth of crystals

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 2 | - | 2 | - | 3 | - | 2 | - | - | 2 | 2 | - | | - |
| CO-2 | - | 2 | - | - | - | - | - | - | - | - | 1 | - | 2 | 2 |
| CO-3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | - | - | 2 | - |
| CO-4 | 2 | - | 1 | - | - | - | - | - | - | - | - | - | 3 | 2 |
| CO-5 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | 2 | - |
| CO-6 | 2 | 2 | 3 | - | - | - | - | - | - | 3 | 2 | - | - | - |

FEM135402: CLOUD COMPUTING

**Objective:** Fundamental for Cloud Computing this course concentrates on delivering the necessary concepts and features.

**Credit: 3** **Semester III** **L-T-P: 2-0-2**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to Cloud Computing**<br>Overview, Roots of Cloud Computing, Layers and Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks | 06 | 10% |
| 2 | **Cloud Architecture, Services and Applications**<br>Exploring the Cloud Computing Stack, Connecting to the Cloud, Infrastructure as a Service, Platform as a Service, Saas Vs. Paas, Using PaaS Application Frameworks, Software as a Service Cloud Deployment Models, Public vs Private Cloud, Cloud Solutions, Cloud ecosystem, Service management, Computing on demand, Identity as a Service, Compliance as a Service | 08 | 15 |
| 3 | **Abstraction and Virtualization**<br>Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines | 08 | 15 |

| | | | |
|---|---|---|---|
| | Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory , I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Center Automation | | |
| **4** | **Cloud Infrastructure and Cloud Resource Management**<br>Architectural Design of Compute and Storage Clouds, Layered Cloud Architecture Development, Design Challenges, Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources. Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards, | **06** | **20** |
| **5** | **Cloud Security**<br>Security Overview, Cloud Security Challenges and Risks, Software-as-a Service Security, Cloud computing security architecture: Architectural Considerations, General Issues Securing the Cloud, Securing Data, Data Security, Application Security, Virtual Machine Security, Identity and Presence, Identity Management and Access Control, Autonomic Security Establishing Trusted Cloud computing, Secure Execution Environments and Communications, , Identity Management and Access control Identity management, Access control, Autonomic Security Storage Area Networks, Disaster Recovery in Clouds<br>**Cloud Based Case-Studies**<br>Overview of Cloud services, Designing Solutions for the Cloud, Implement & Integrate Solutions, Emerging Markets and the Cloud, Tools for Building Private Cloud: IaaS using Eucalyptus, PaaS on IaaS - AppScale | **12** | **40** |

**Reference Books:**

1. Rajkumar Buyya et. el., Cloud Computing: Principles and Paradigms, Wiley India Edition
2. Sosinsky B., “Cloud Computing Bible”, Wiley India

3. Mastering Cloud Computing by Rajkumar Buyya, C. Vecchiola & S. Thamarai SelviMcGRAW Hill Publication

4. Miller Michael, "Cloud Computing: Web Based Applications that Change the Way You Work and Collaborate Online", Pearson Education India

5. Velte T., Velte A., Elsenpeter R., "Cloud Computing – A practical Approach", Tata McGrawHill

**Course Outcome:**

CO-1: Understand the concepts and terminologies of Cloud computing and virtualization
CO-2: Understand the Cloud computing architecture and the Aneka cloud computing platform.
CO-3: Understand programming applications with Thread and Task-based application models.
CO-4: Understand Data intensive computing and Map-Reduce programming model.
CO-5: Understand the Cloud platforms in industry such as Amazon web services, Google AppEngine, Microsoft Azure and Cloud scientific applications.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | | |
| CO-1 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO-2 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | 2 | - |
| CO-3 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | 2 | - |
| CO-4 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO-5 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | 2 | - |

**List of Suggested Practical:**

1. Sketch out and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
2. Create a scenario in Aneka / Eucalyptus to create a datacenter and host. Also create virtual machines with static configuration to run cloudlets on them.

3. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
4. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.
5. Sketch out and analyze architecture of Microsoft Azure.
6. Sketch out and analyze architecture of Amazon Web Service (AWS).
7. Categorize Microsoft Azure Services and discuss on each.
8. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
9. Implement and use sample cloud services with the help of Microsoft Azure.
10. Create a sample mobile application using Microsoft Azure account as a cloud service. Also provide database connectivity with implemented mobile application.
11. Create a sample mobile application using Amazon Web Service (AWS) account as a cloud service. Also provide database connectivity with implemented mobile application.

FEM135404: SEMANTIC WEB

**Objective:** The rationale behind such a system is that most of the data currently posted on the web is buried in HTML files suitable for human reading and not for computers to manipulate meaningfully. The semantic Web, an extension of the current web, can be thought of as a globally linked database where information is given well-defined meaning using metadata for better enabling computers and humans to work in close cooperation.

**Credit: 3** **L-T-P: 3-0-0**

**Teaching & Evaluation Scheme:-**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 3 | 0 | 2 | 5 | 4 | 70 | 30 | 30 | 20 | 150 |

| Sr. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Semantic Web Vision:** Todays' web, Examples of semantic web from today's web, Semantic web technologies, layered approach **Structured web documents in XML:** The XML language, Structuring, Namespaces, Querying and Addressing XML documents, Processing | 10 | 25% |
| 2 | **Describing Web Resources:** Introduction, RDF , RDF Schema syntax and language, Direct Inference System, Querying RQL | 07 | 15% |
| 3 | **Web Ontology Language:** Introduction, OWL language, Examples, OWL in OWL, Future extensions | 07 | 15% |
| 4 | **Logic and Inference: Rules:** Introduction, Monotonic Rules syntax, semantics & examples, | 15 | 27% |

| | | | |
|---|---|---|---|
| | Nonmonotonic rules – syntax & examples, Encoding in XML<br>**Applications:**<br>Introduction, Horizontal Information Products at Elsevier, Data Integration at Audi, Skill Finding at Swiss Life, Think Tank portal at EnerSearch, e-Learning, Web Services, Other Scenarios | | |
| **5** | **Ontology Engineering:**<br>Introduction, Manual construction of Ontology, Reusing existing ontology, using Semi-automatic methods, Knowledge semantic web architecture<br>**Conclusion and Outlook:**<br>How it fits together?, Issues and future trends | **07** | **18%** |

**Reference Books:**

1. A Semantic web Primer: Grigoris Antoniou and Frank Van Hermelen , MIT Press.
2. Foundations of Semantic Web Technologies, Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, CRC Press.
3. Semantic Web programming, John Hebleret.el, Wiley.

**Course Outcome:**

CO-1: To apply differential and integral calculus to improper integrals and to determine applications of definite integral. Apart from some other applications they will have a basic understanding of indeterminate forms, Beta and Gamma functions
CO-2: To apply the various tests of convergence to sequence, series and the tool of power series and Fourier series for learning advanced Engineering Mathematics
CO-3: To compute directional derivative, maximum or minimum rate of change and optimum value of functions of several variables
CO-4: Mathematics has the potential to understand the core Technological studies
CO-5: To compute the areas and volumes using multiple integral techniques
CO-6: To perform matrix computation in a comprehensive manner

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 2 | - |
| CO-2 | - | - | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| CO-3 | - | - | 1 | - | 3 | - | - | - | - | - | - | - | 2 | 2 |
| CO-4 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 |
| CO-5 | - | - | 1 | 3 | - | - | - | - | - | - | - | - | 2 | - |
| CO-6 | 2 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | - | 2 | - |

**List of experiments:**

1. Working with XML,
2. Working with XML Schema, DTD
3. Design Of Ontology using RDF
4. Design RDF document with different Serialization format (e.g. tutle,N-triple)
5. Design Of Ontology using RDFS
6. Design Of Ontology using OWL
7. Case study : Pizza Ontology
8. Querying Ontology using SPARQL
9. Design of any domain specific Ontology in Protégé
10. Case Study : Dbpedia
11. Case study : LOD Cloud

FEM135408: DISSERTATION PHASE-I

**Objective:** The objectives of research may vary depending on the field of study and the specific research question being investigated.

**Credit: 8** **L-T-P: 0-0-16**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | | Examination Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | Credits | SEE (E) | PA (M) | Viva (V) | PA (I) | Total Marks |
| 0 | 0 | 16 | 16 | 8 | 00 | 00 | 100 | 00 | 100 |

**Course Outcome:**

CO-1: To apply differential and integral calculus to improper integrals and to determine applications of definite integral. Apart from some other applications they will have a basic understanding of indeterminate forms, Beta and Gamma functions
CO-2: To apply the various tests of convergence to sequence, series and the tool of power series and Fourier series for learning advanced Engineering Mathematics
CO-3: To compute directional derivative, maximum or minimum rate of change and optimum value of functions of several variables
CO-4: Mathematics has the potential to understand the core Technological studies
CO-5: To compute the areas and volumes using multiple integral techniques
CO-6: To perform matrix computation in a comprehensive manner

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 3 | - | 2 | - | - | - | - | - | - | - | - | - | 3 | 3 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-2** | - | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **CO-3** | 2 | - | - | - | - | - | - | - | - | - | 2 | - | - | - |
| **CO-4** | - | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 | 3 |
| **CO-5** | 3 | - | - | 3 | - | - | - | - | - | 2 | 2 | 3 | - | 3 |
| **CO-6** | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | 2 | 3 | - |

FEM135407: INTERNAL REVIEW - I

**Objective:** The objectives of research may vary depending on the field of study and the specific research question being investigated.

**Credit: 2** **L-T-P: 0-0-4**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 0 | 0 | 4 | 4 | 2 | 00 | 00 | 00 | 100 | 100 |

FEM145402: DISSERTATION PHASE-II

**Objective:** The objectives of research may vary depending on the field of study and the specific research question being investigated.

**Credit: 14** **Semester IV** **L-T-P: 0-0-28**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | | SEE (E) | PA (M) | Viva (V) | PA (I) | |
| 0 | 0 | 28 | 28 | 14 | 00 | 00 | 100 | 00 | 100 |

**Course Outcome:**

After learning the course the students should be able to:
CO1: Apply the research methodology tools for data collection and analysis.
CO2 : Perform the related investigation with the help of available software and hardware tools
CO3 : Interpret the research outcomes through various statistical tools and validate them.
CO4 : Deduce the relevant/ substantial technical content from the compiled data and compose research publications
CO5: Communicate the research outcomes through an effective report.

| Course Outcomes | Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 |
| CO-1 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | - | - | - | 3 | 3 |
| CO-2 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 1 | - | - | 3 | - |
| CO-3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | 3 | 3 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-4** | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | - | 1 | - | 3 | - |
| **CO-5** | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | - | - | - | 3 | 3 |
| **CO-6** | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |

3

FEM145401: INTERNAL REVIEW - II

**Objective:** The objectives of research may vary depending on the field of study and the specific research question being investigated.

**Credit: 2** **L-T-P: 0-0-4**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | | | Examination Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | | Practical | | |
| Th | Tu | P | Total | Credits | SEE (E) | PA (M) | Viva (V) | PA (I) | Total Marks |
| 0 | 0 | 4 | 4 | 2 | 00 | 00 | 00 | 100 | 100 |