GOKUL GLOBAL UNIVERSITY

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
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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**

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, distributed systems, Bioinformatics, Machine learning	**10**	**21%**
6	Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision	**6**	**13%**

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: To understand the mathematical fundamentals that is prerequisites 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

CO-2: To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency

CO-3: To study various sampling and classification problems.

CO-4: Students will learn fundamentals and applications of graph theory for engineering problems.

CO-5: Carry out interpolations and curve fitting

CO-6: Students will learn fundamentals and applications of probability for engineering 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**
CO-1	3	2	2	2	3	2	2	-	-	2	2	2
CO-2	3	2	-	-	3	1	2	-	-	-	1	1
CO-3	3	2	2	2	2	2	2	-	-	2	-	-
CO-4	3	2	2	2	2	2	-	-	-	2	-	-
CO-5	3	2	-	1	1	2	3	-	-	-	2	-
CO-6	3	2	2	-	-	1	1	-	-	3	2	2

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**

Sr.	Content	Total Hrs	% Weightage
1	**Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** 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:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	**05**	**10%**
3	**Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	**09**	**15%**
4	**Text Processing:** 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	**12**	**25%**

	Programming to the LCS Problem.		
5	**Computational Geometry:** 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. **Recent Trends in Hashing** 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**
CO-1	3	2	2	2	3	-	-	1	2	2	1	1
CO-2	3	1	3	2	2	-	-	1	2	2	2	2
CO-3	3	3	2	2	1	-	-	1	3	2	1	2
CO-4	3	2	3	1	2	-	-	-	3	2	2	-

CO-5	3	2	2	2	2	-	-	2	3	2	1	2
CO-6	2	2	2	2	2	-	-	1	2	2	1	1

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**

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:** 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:** Technologies for visualisation, Bokeh (Python)	07	10%
6	**Recent trends in various data collection and analysis techniques:** various visualization techniques, application development methods of	07	15%

	used in data science.		

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: Explain how data is collected, managed and stored for data science;
CO-2: Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
CO-3: Implement data collection and management scripts using MongoDB.
CO-4: Dive deeply into a chosen area of practice to fully prepare to use knowledge gained in the program to add significant value in a professional setting
CO-5: Be able to utilize knowledge and skills to continue learning and adapting to new data science technologies
CO-6: Apply data science concepts and methods to **solve** problems in real-world contexts and will **communicate** these solutions effectively.

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
CO-1	3	2	2	2	-	-	-	1	1	2	-	-
CO-2	3	3	3	2	-	-	-	1	1	2	-	1
CO-3	2	3	3	3	3	-	-	1	1	2	-	1
CO-4	2	3	2	2	-	-	-	1	1	2	-	-
CO-5	2	3	2	3	-	-	-	1	1	2	-	-
CO-6	2	2	3	2	-	-	-	1	1	2	-	1

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**

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: Learn the basics of learning problems with hypothesis and version spaces

CO-2: Understand the features of machine learning to apply on real world problems

CO-3: Characterize the machine learning algorithms as supervised learning and unsupervised learning and Apply and analyzethe various algorithms of supervised and unsupervised learning.

CO-4: Analyze the concept of neural networks for learning linear and non-linear activation functions.

CO-5: Learn the concepts in Bayesian analysis from probability models and methods.

CO-6: Understand the fundamental concepts of Genetic Algorithm and Analyze and design the genetic algorithms for optimization engineering 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
CO-1	3	2	1	-	3	1	-	-	-	-	2	1
CO-2	2	-	2	-	3	-	-	2	-	2	-	-

CO-3	3	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	2	-	1	-	2	1	-	-	2	1	1
CO-5	3	1	-	1	2	-	1	-	-	-	-	-
CO-6	2	2	2	-	-	2	-	1	-	2	1	-

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**

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	7	18%
4	**Methods of Data Collection** 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	7	16%
5	**Data Analysis** 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	7	12%

	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		
6	**Interpretation of Data and Paper Writing** 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.	**4**	**10%**
7	**Report Writing** 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 **Patent Rights** 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

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: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO-6: Analyze research related information.

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**
CO-1	3	3	2	2	3	-	-	1	2	3	1	2
CO-2	3	3	2	2	3	-	-	1	3	2	2	1
CO-3	2	3	3	2	1	-	-	1	2	2	1	2
CO-4	3	2	2	1	2	-	-	-	2	3	2	-
CO-5	3	2	2	2	2	-	-	2	2	2	1	1
CO-6	1	2	2	2	3	-	-	1	3	2	2	1

FEM110002: DISASTER MANAGEMENT

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

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

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 Survival.	**4**	**16**
6.	**Disaster Mitigation:** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	**4**	**16**

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
CO-1	3	2	2	2	3	-	-	1	2	2	1	1
CO-2	3	2	2	1	2	-	-	1	3	2	2	1
CO-3	3	3	1	2	1	-	-	1	2	2	2	2
CO-4	3	3	3	2	2	-	-	-	2	3	2	-
CO-5	3	2	3	2	3	-	-	2	3	2	2	2
CO-6	1	3	2	2	2	-	-	1	3	3	1	2

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**

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 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 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**
CO-1	3	3	2	3	-	-	-	-	-	-	-	-
CO-2	3	2	2	2	-	-	-	-	-	-	-	-
CO-3	3	3	2	2	-	-	-	-	-	-	-	-
CO-4	3	3	2	3	-	-	-	-	-	-	-	-
CO-5	3	3	2	3	-	-	-	-	-	-	-	-
CO-6	3	3	3	3	-	-	-	-	-	-	-	-

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**

Sr.	Content	Total Hrs	% Weightage
1	**Digital Image Fundamentals:** 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:** In spatial domain: Basic gray level transformations, Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters. 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:** Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering. **Color Image Processing:** Color fundamentals, Color models, Color transformation, Smoothing and Sharpening, Color segmentation.	10	25%

4	**Wavelet and Multi-resolution Processing:** Image pyramids, Multi-resolution expansion, wavelet transform. **Image Compression:** Introduction, Image compression model, Error-free compression, Lossy compression.	**09**	**15%**
5	**Morphological Image Processing:** 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.	**06**	**15%**
6	**Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, thresholding.	**05**	**05%**

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: Review the fundamental concepts of a digital image processing system.

CO2: Analyze images in the frequency domain using various transforms.

CO3: Evaluate the techniques for image enhancement and image restoration.

CO4: Categorize various compression techniques.

CO5: Interpret Image compression standards.

CO6: Interpret image segmentation and representation 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**
CO-1	3	-	-	-	-	-	-	-	3	-	-	-
CO-2	2	-	3	-	-	-	-	3	-	-	-	-
CO-3	2	2	2	-	-	-	-	2	2	1	-	-
CO-4	2	2	-	-	3	-	1	-	-	2	3	3
CO-5	-	3	-	-	3	3	1	3	-	2	-	2
CO-6	-	-	-	3	3	2	-	1	-	1	-	2

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**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Data Mining** 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** 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** Rule Mining, Mining of Single dimensional Boolean association rules, Multilevel association rules and Multidimensional association rules, Correlation analysis, Constraint based association Mining.	06	10%
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.	**06**	**15%**
6	**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.	**10**	**15%**

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**
CO-1	3	-	-	-	-	-	-	-	-	-	-	2
CO-2	2	-	-	-	-	-	-	-	-	-	-	3
CO-3	2	3	-	-	-	-	-	-	-	-	-	2
CO-4	2	2	-	-	-	-	-	-	-	-	-	3
CO-5	2	3	-	-	-	-	-	-	-	-	-	2
CO-6	-	-	-	-	-	-	-	-	-	-	-	-

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**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction:** 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 –** Integration versus interoperation , J2EE ,.NET, Model Driven Architecture , Concepts of Distributed Computing, XML	**08**	**11%**
3	**Basic concepts –** 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-** WS-* Specifications: 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-** 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**
CO-1	2	-	-	1	-	2	-	-	2	2	2	-
CO-2	2	3	-	-	-	-	1	-	3	2	-	-
CO-3	2	3	-	2	-	1	-	2	-	2	1	-
CO-4	2	3	-	2	-	2	-	2	-	2	2	3
CO-5	2	3	-	2	-	1	-	2	-	2	-	3
CO-6	2	3	-	2	-	1	-	2	-	2	2	3

FEM125409: MINI PROJECT WITH SEMINAR

Objective: Research

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

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**
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**

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	**4**	**16**
6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**4**	**16**

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**
CO-1	2	-	2	1	3	-	2	3	2	2	2	-
CO-2	3	2	-	-	-	-	-	3	2	-	1	-
CO-3	2	2	2	3	-	-	-	1	2	2	-	-
CO-4	2	-	1	2	-	-	-	3	-	2	-	-
CO-5	3	2	-	1	-	-	-	-	2	-	2	-
CO-6	2	2	3	-	-	-	-	3	2	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**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Cloud Computing** 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** 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** Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines 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	08	15
4	**Cloud Infrastructure and Cloud Resource Management**	06	20

	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,		
5	**Cloud Security** 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	**08**	**20**
6	**Cloud Based Case-Studies** 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	**04**	**20**

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: 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**
CO-1	3	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	-	1	-	-	-	-	-	-	-	-	-
CO-3	3	1	-	-	-	-	-	-	-	-	-	-
CO-4	3	2	3	-	-	-	-	-	-	-	-	-
CO-5	3	2	3	-	-	-	-	-	-	-	-	-
CO-6	3	2	3	-	-	-	-	-	-	-	-	-

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**

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, Nonmonotonic rules – syntax & examples, Encoding in XML **Applications:** 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	15	27%
5	**Ontology Engineering:** Introduction, Manual construction of Ontology, Reusing existing ontology, using Semi-automatic methods, Knowledge semantic web architecture **Conclusion and Outlook:**	07	18%

	How it fits together?, Issues and future trends		

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**
CO-1	1	1	1	1	-	-	-	-	-	-	-	-
CO-2	-	-	3	3	-	-	-	-	-	-	-	2
CO-3	-	-	1	-	3	-	-	-	-	-	-	-
CO-4	2	2	2	2	-	-	-	-	-	-	-	-
CO-5	-	-	1	3	-	-	-	-	-	-	-	-
CO-6	2	2	2	2	3	-	-	-	-	-	-	-

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**

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**
CO-1	3	3	2	-	-	-	-	-	-	-	-	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	3
CO-3	3	3	2	-	-	-	-	-	-	-	2	3
CO-4	3	3	3	-	-	-	-	-	-	-	3	2
CO-5	3	3	2	3	-	-	-	-	-	2	2	3
CO-6	3	3	3	-	-	-	-	-	-	3	3	2

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**

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**

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
CO-1	3	3	3	-	-	3	3	3	-	-	-	-
CO-2	3	3	3	-	-	3	3	3	-	1	-	-
CO-3	3	3	3	-	-	3	3	3	-	2	-	-
CO-4	3	3	3	-	-	3	3	3	-	-	1	-
CO-5	3	3	3	-	-	3	3	3	-	-	-	-
CO-6	-	-	-	-	-	-	-	-	-	-	-	-

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**