SEMESTER- I

MT-CSL-101 Mathematical Foundation of Computer Science

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Discrete Mathematics

Course Objectives:

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.
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.
3. To study various sampling and classification Problems.

UNIT -1

Module-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

UNIT -II

Module-2:

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

Module-3:

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

UNIT -III

Module-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

UNIT -IV

Module-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.

Module-6:

Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing and computer vision.

Course Outcomes:

After completion of course, students would be able to:

a. To understand the basic notions of discrete and continuous probability.
b. To understand the methods of statistical inference, and the role that sampling distributions play in those method.
c. To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

References

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

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-102 **Advanced Data Structures**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: UG level course in Data Structures

Course Objectives:

1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary mathematical abstraction to solve problems.
3. To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4. Student should be able to come up with analysis of efficiency and proofs of correctness.

UNIT -I

Module-1:

Dictionaries and Hashing

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.

UNIT -II

Module-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

Module-3:

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

UNIT -III

Module-4:

Text Processing

Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore 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.

UNIT -IV

Module-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.

Module-6:

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

Course Outcomes:

a. Understand the implementation of symbol table using hashing techniques.
b. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
c. Develop algorithms for text processing applications.
d. Identify suitable data structures and develop algorithms for computational geometry problems.

References

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

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-105 **Machine Learning (Elective I)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Basics of Neural Networks and Image Processing

Course Objectives:

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

UNIT -I

Module-1: Supervised Learning (Regression/Classification)

- Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes
- Linear models: Linear Regression, Logistic Regression, Generalized Linear Models
- Support Vector Machines, Nonlinearity and Kernel Methods
- Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

UNIT -II

Module-2: Unsupervised Learning

- Clustering: K-means/Kernel K-means
- Dimensionality Reduction: PCA and kernel PCA
- Matrix Factorization and Matrix Completion
- Generative Models (mixture models and latent factor models)

UNIT -III

Module-3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module-4:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

UNIT -IV

Module-5:

Scalable Machine Learning (Online and Distributed Learning)
A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module-6:

Recent trends in various learning techniques of machine learning and classification methods for IOT applications, various models for IOT applications

Course Outcomes:

a. Extract features that can be used for a particular machine learning approach in various IOT applications.
b. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
c. To mathematically analyse various machine learning approaches and paradigms.

References

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-106 **Wireless Sensor Networks (Elective I)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Wireless Communication

Course Objectives:

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and has a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks

UNIT-I

Module-1:

Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors

Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture

Hardware Platforms: Motes, Hardware parameters

Module-2:

Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

UNIT-II

Module-3:

Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled

Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis

MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

UNIT-III

Module-4:

Routing protocols: Introduction, MANET protocols

Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast

Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain), advanced topics in wireless sensor networks.

UNIT-IV

Module-5:

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key Distribution

Module-6:

Advanced Topics

Recent development in WSN standards, software applications

Course Outcomes

After completion of course, students would be able to:

- Describe and explain radio standards and communication protocols for wireless sensor networks.
- Explain the function of the node architecture and use of sensors for various applications.
- Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.

References:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010

2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks - Technology, Protocols, and Applications", Wiley Interscience 2007

3. Takahiro Hara, Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-107 **Introduction to Intelligent Systems (Elective I)**

L	T	P	Total Credits: 3
3	0	0	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Data Structures and Data Management or Data Structures

Course Objectives:

The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

UNIT-I

Module-1:
Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks

Module-2:
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

UNIT-II

Module-3:
Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill-climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

UNIT-III

Module-4:
Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs, Formal logic and logical inference, Knowledge-based systems structures, its basic components, Ideas of Blackboard architectures

UNIT-IV

Module-5:

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Module-6:

Recent trends in Fuzzy logic, Knowledge Representation

Course Outcomes:

Able to Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyse and compare the relative merits of a variety of AI problem solving techniques.

References

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.

2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-108 **Data Science (Elective II)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites:

Course Objectives:

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 analyses a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data;

UNIT -I

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

UNIT- II

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.

UNIT -III

Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT -IV

Applications of Data Science, Technologies for visualisation, Bokeh (Python)

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Course Outcomes

On completion of the course the student should be able to

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

References:

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.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-109 **Distributed Systems (Elective II)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Database Management Systems

Course Objectives:

1. To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

UNIT I

Module-1:

Introduction
Distributed data processing, what is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts
Distributed Database Management System Architecture Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

UNIT II

Module-2:

Distributed Database Design
Alternative design strategies; Distributed design issues; Fragmentation; Data allocation
Semantics Data Control
View management; Data security; Semantic Integrity Control
Query Processing Issues
Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

UNIT III

Module-3:

Distributed Query Optimization
Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

Transaction Management

The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

Concurrency Control

Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

UNIT IV

Module-4:

Reliability

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols.

Module-5:

Parallel Database Systems

Parallel architectures; parallel query processing and optimization; load balancing

Module-6:

Advanced Topics

Mobile Databases, Distributed Object Management, Multi-databases

Course Outcomes:

a. Design trends in distributed systems.
b. Apply network virtualization.
c. Apply remote method invocation and objects.

References

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-110 **Advanced Wireless and Mobile Networks**

(Elective II)

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites Computer Networks

Course Objective

- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations
- To learn how to design and analyse various medium access
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.

UNIT -I

Introduction:

Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.

Wireless Local Area Networks:

IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues

UNIT -II

Wireless Cellular Networks:

1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

UNIT -III

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview

Wireless Sensor Networks

Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview

UNIT -IV

Wireless PANs

Bluetooth AND Zigbee, Introduction to Wireless Sensors

Security

Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication

Advanced Topics

IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks

Course Outcomes

After completion of course, students would be:

- Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
- Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
- Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
- Design wireless networks exploring trade-offs between wire line and wireless links.
- Develop mobile applications to solve some of the real world problems.

References

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-RM-101 **Research Methodology and IPR**

L	T	P	Total Credits: 3
3	0	-	External Marks: 40
			Internal Marks: 10

Duration of Exam: 3 Hrs.

Pre-requisites:

Course Objectives:

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property
   Right to be promoted among students in general & engineering in particular
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT -I

Module-1:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Module-2:

Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT -II

Module-3:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module-4:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

UNIT -III

Module-5:

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications

UNIT -IV

Module-6:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs

Course Outcomes:

a. To identify sources of research problem and approaches of investigation for solutions for research problem.
b. To learn various research ethics.
c. To learn the concepts of patents, procedure for granting patents and administration of patent system.

References

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSP-103 Laboratory 1 (Advanced Data Structures)

L	T	P
-	-	4

Total Credits: 2
External Marks: 40
Internal Marks: 10

At least 10 to 15 exercises related to the subject should be given by the teacher concerned**.**

MT-CSP-104 **Laboratory 2 (Based on Electives)**

L	T	P
-	-	4

Total Credits: 2
External Marks: 40
Internal Marks: 10

At least 20 exercises related to the electives subject (i.e.10 exercises from each subject) should be given by the teacher concerned**.**

SEMESTER- II

MT-CSL-201 **Advance Algorithms**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			InternalMarks:20

Duration of Exam: 3 Hrs.

Pre-requisites: UG level course in Algorithm Design and Analysis

Course Objectives:

1. Introduce students to the advanced methods of designing and analyzing algorithms.
2. The student should be able to choose appropriate algorithms and use it for a specific problem.
3. To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4. Students should be able to understand different classes of problems concerning their computation difficulties.
5. To introduce the students to recent developments in the area of algorithmic design.

UNIT - I

Module-1:
Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT - II

Module-2:
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set, Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path
Module-3:
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition

UNIT - III

Module-4:

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm, more examples of dynamic programming

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation, Extension to polynomials, Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm, Schonhage-Strassen Integer Multiplication algorithm

UNIT - IV

Module-5:

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest

Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Module-6:

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Course Outcomes:

a. Analyze the complexity/performance of different algorithms.
b. Determine the appropriate data structure for solving a particular set of problems.
c. Categorize the different problems in various classes according to their complexity.
d. Students should have an insight of recent activities in the field of the advanced data structure

References

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-202 **Soft Computing**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-requisites: Basic knowledge of mathematics

Course Objectives:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario
2. To implement soft computing based solutions for real-world problems
3. To give students knowledge of non-traditional technologies and fundamentals of artificial
4. neural networks, fuzzy sets, fuzzy logic, genetic algorithms
5. To provide student an hand-on experience on MATLAB to implement various strategies

UNIT - I

Module-1: Introduction to Soft Computing and Neural Networks

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Module-2: Fuzzy Logic

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

UNIT - II

Module-3: Neural Networks

Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

UNIT - III

Module-4: Genetic Algorithms

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition

UNIT - IV

Module-5: Matlab/Python Lib

Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Module-6:

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm, Implementation of recently proposed soft computing techniques

Course Outcomes:

a. Identify and describe soft computing techniques and their roles in building intelligent machines
b. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
c. Apply genetic algorithms to combinatorial optimization problems.
d. Evaluate and compare solutions by various soft computing approaches for a given problem.

References

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-206 **Data Preparation and Analysis (Elective III)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites: Basics of Data Collection and Analysis, statistics

Course Objective:
To prepare the data for analysis and develop meaningful Data Visualizations

UNIT-I

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

UNIT-II

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

UNIT-III

Exploratory Analysis:
Descriptive and comparative statistics, Clustering and association, Hypothesis generation

UNIT-IV

Visualization:
Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

Course Outcomes
After completion of course, students would be: Able to extract the data for performing the Analysis.

References:
1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-207 **Secure Software Design and Enterprise computing (Elective III)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites Computer Programming, Software Engineering

Course Objective

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

UNIT -I

Secure Software Design

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

UNIT -II

Enterprise Application Development

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

UNIT -III

Enterprise Systems Administration

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

UNIT -IV

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

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

Case study of DNS server, DHCP configuration and SQL injection attack

Course Outcomes

After completion of course, students would be able to:

- Differentiate between various software vulnerabilities.
- Software process vulnerabilities for an organization.
- Monitor resources consumption in a software.
- Interrelate security and software development process.

References:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett

2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security,Addison Wesley.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-208 **Computer Vision (Elective III)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites: Linear algebra, vector calculus, Data structures and Programming.

Course Objective

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks.

UNIT -I

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and binary image analysis
Edge detection, Edge detection performance, Hough transform, corner detection

UNIT -II

Segmentation, Morphological filtering, Fourier transform
Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing

UNIT -III

Pattern Analysis:
Clustering: K-Means, K-Medoids, Mixture of Gaussians
Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised
Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

UNIT -IV

Recent trends in Activity Recognition, computational photography, Biometrics.

Course Outcomes

After completion of course, students would be able to:

- Developed the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images.

References

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-209 **Human and Computer Interaction (Elective IV)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Course Objective

- Learn the foundations of Human Computer Interaction
- Be familiar with the design technologies for individuals and persons with disabilities
- Be aware of mobile Human Computer interaction.
- Learn the guidelines for user interface.

UNIT -I

Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT -II

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT -III

Cognitive models –Socio-Organizational issues and stake holder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT -IV

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies
Recent Trends: Speech Recognition and Translation, Multimodal System

Course Outcomes

After completion of course, students would be:

- Understand the structure of models and theries of human computer interaction and vision.

- Design an interactive web interface on the basis of models studied.

References

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O□Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O□Reilly, 2009. (UNIT-V)

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-210 **GPU Computing (Elective IV)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites: Computer Architecture and Organization

Course Objective

- To learn parallel programming with Graphics Processing Units (GPUs).

UNIT -I

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

UNIT -II

Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

UNIT -III

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists Synchronization across CPU and GPU

Functions: Device functions, Host functions, Kernels functions, using libraries (such as Thrust), and developing libraries.

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

UNIT -IV

Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Course Outcomes

After completion of course, students would be:

- Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

References

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)

2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-211 **Digital forensics (Elective IV)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			Internal Marks: 20

Duration of Exam: 3 Hrs.

Pre-Requisites Cybercrime and Information Warfare, Computer Networks

Course Objective

- Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

UNIT -I

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT -II

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT -III

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT -IV

Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

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

- Understand relevant legislation and codes of ethics
- Computer forensics and digital detective and various processes, policies and procedures
- E-discovery, guidelines and standards, E-evidence, tools and environment.
- Email and web forensics and network forensics

References

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-203 **Mini Project with Seminar**

L	T	P	Total Credits: 2
2	-	-	Internal Marks: 50

Students may choose a project based on any subject of Computer Science & Engineering /Network Security. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars. An assigned teacher will evaluate the performance of the students & marks will be awarded accordingly**.**

MT-CSP-204 **Laboratory 3 (Based on Cores)**

L	T	P	Total Credits: 2
-	-	4	External Marks: 40
			Internal Marks: 10

At least 20 exercises related to the core subjects (i.e.10 exercises from each subject) should be given by the teacher concerned**.**

MT-CSP-205 **Laboratory 4 (Based on Electives)**

L	T	P	Total Credits: 2
-	-	4	External Marks: 40
			Internal Marks: 10

At least 20 exercises related to the elective subjects (i.e.10 exercises from each subject) should be given by the teacher concerned**.**

SEMESTER- III

MT-CSL-301 **Mobile Applications and Services (Elective V)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			InternalMarks:20

Duration of Exam: 3 Hrs.

Pre-requisites: Wireless Communication and Mobile Computing

Course Objective

- This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
- It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets
- It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile

UNIT -I

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

UNIT -II

Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics

UNIT -III

Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

UNIT -IV

Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, More on Security, Hacking Android

Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT

Course Outcomes

- On completion of the course the student should be able to identify the target platform and users and be able to define and sketch a mobile application
- understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap
- Design and develop a mobile application prototype in one of the platform (challenge project)

References

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-302 **Compiler for HPC (Elective V)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			InternalMarks:20

Duration of Exam: 3 Hrs.

Pre-Requisites Data Structure, Compiler Design, Theory of Computation

Course Objective

- The objective of this course is to introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

UNIT-I

High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance

Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.

Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays

UNIT-II

Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis

Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality

UNIT-III

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

UNIT-IV

Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

Course Outcomes

After completion of course, students would be:

- Familiar with the structure of compiler.
- Parallel loops, data dependency and exception handling and debugging in compiler.

References

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSL-303 **Optimization Techniques (Elective V)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80
			InternalMarks:20

Duration of Exam: 3 Hrs.

Pre-Requisites Linear Algebra and Numerical Methods

Course Objective

- The objective of this course is to provide insight to the mathematical formulation of real world problems.
- To optimize these mathematical problems using nature based algorithms. And the solution is useful especially for NP-Hard problems.

UNIT -I

Engineering application of Optimization, Formulation of design problems as mathematical programming problems

General Structure of Optimization Algorithms, Constraints, The Feasible Region.

UNIT -II

Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

UNIT-III

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

UNIT -IV

Real life Problems and their mathematical formulation as standard programming problems

Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

Course Outcomes

After completion of course, students would be:

- Formulate optimization problems.
- Understand and apply the concept of optimality criteria for various types of optimization problems.
- Solve various constrained and unconstrained problems in Single variable as well as multivariable.
- Apply the methods of optimization in real life situation.

References

1. Laurence A. Wolsey (1998). Integer programming, Wiley, ISBN 978-0-471-28366-9
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005), Optimization over integers, Dynamic Ideas, ISBN 978-0-9759146-2-5
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493- 1914-3
6. H. Paul Williams (2009). Logic and Integer Programming Springer. ISBN 978-0-387-92279-9
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3- 540-68274-5
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution, John Wiley and Sons. ISBN 978-0-470-37306-4

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-301 **Business Analytics (Open Elective)**

L T P **Total Credits: 3**

3 0 - **External Marks: 80**
Internal Marks: 20

Duration of Exam: 3 Hrs.

Course Objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT-I

Module-1:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module-2:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.
Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

UNIT-II

Module-3:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-III

Module-4:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-IV

Module-5:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value ofInformation, Utility and Decision Making.

Module-6:
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

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

a. Students will demonstrate knowledge of data analytics.
b. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
c. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
d. Students will demonstrate the ability to translate data into clear, actionable insights.

References

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-302 **Industrial Safety (Open Elective)**

L T P **Total Credits: 3**

3 0 - **External Marks: 80**
Internal Marks: 20

Duration of Exam: 3 Hrs.

UNIT-I

Module-1:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods

Module-2:

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

UNIT-II

Module-3:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods

UNIT-III

Module-4:

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-IV

Module-5:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-303 **Operations Research (Open Elective)**

L T P **Total Credits: 3**

3 0 - **External Marks: 80**
Internal Marks: 20

Duration of Exam: 3 Hrs.

UNIT-I

Module-1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT-II

Module-2:

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT-III

Module-3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module-4:

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT-IV

Module-5:

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Course Outcomes:

After completion of course, students would be able to:

a. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
b. Students should able to apply the concept of non-linear programming.
c. Students should able to carry out sensitivity analysis.
d. Student should able to model the real world problem and simulate it.

References

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-304 **Cost Management of Engineering Projects (Open Elective)**

L	T	P	Total Credits: 3
3	0	-	External Marks: 80 Internal Marks: 20

Duration of Exam: 3 Hrs.

UNIT-I

Module-1:

Introduction and Overview of the Strategic Cost Management Process

Module-2:

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making

UNIT-II

Module-3:

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts, Types and contents, Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT-III

Module-4:

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis., Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets., Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-IV

Module-5:

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

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-305 **Composite Materials (Open Elective)**

L T P **Total Credits: 3**

3 0 - **External Marks: 80**
Internal Marks: 20

Duration of Exam: 3 Hrs.

UNIT-I

Module-1: Introduction

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

Module-2: **Reinforcements**
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions

UNIT-II

Module-3: **Manufacturing Of Metal Matrix Composites**
Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing, Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications

UNIT-III

Module-4: **Manufacturing Of Polymer Matrix Composites**
Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications

UNIT-IV

Module-5: Strength
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-OE-306 **Waste to Energy (Open Elective)**

L T P **Total Credits: 3**

3 0 - **External Marks: 80**
Internal Marks: 20

Duration of Exam: 3 Hrs.

UNIT-I

Module-1: Introduction To Energy From Waste

Waste: Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Module-2: Biomass Pyrolysis

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yieldsand application – Manufacture of pyrolytic oils and gases, yields and applications

UNIT-II

Module-3: Biomass Gasification

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermalheating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration ingasifier operation.

UNIT-III

Module-4: Biomass Combustion

Biomass stoves – Improved chullahs, types, some exotic designs, Fixedbed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction andoperation - Operation of all the above biomass combustors.

UNIT-IV

Module-5: Biogas

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology andstatus - Bio energy system - Design and constructional features - Biomass resources and theirclassification - Biomass conversion processes - Thermo chemical conversion – Directcombustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Typesof biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban wasteto energy conversion - Biomass energy programme in India

References

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, TataMcGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

MT-CSP-304 **Dissertation-I /Industrial Project**

L	T	P	Total Credits: 8
0	0	16	External Marks: 200
			Internal Marks: 50

Dissertation phase-I mainly focus on the problem defining and literature survey specific to the problem. The student will submit a synopsis at the beginning of the semester for the approval from the project committee in a specified format that clearly define the problem.

MT-CSP-305 **Industrial Training**

L	T	C	Total Credits: 2
0	0	2	External Marks: 50

Practical training conducted after second semester will be evaluated in the third semester based on Viva-Voce.

SEMESTER-IV

Dissertation Phase-II

Code No: MT-CSP-401			**Total Credits: 16**
L	**T**	**P**	**External Marks: 400**
-	-	32	**Internal Marks: 100**

The student will submit a synopsis at the beginning of the semester for the approval from the project committee in a specified format. Synopsis must be submitted within a two weeks. The first defence, for the dissertation work, should be held with in a one month. Dissertation Report must be submitted in a specified format to the project committee for evaluation purpose.