**Avinashilingam Institute for Home Science and Higher Education for Women**
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with 'A' Grade by NAAC. Recognized by UGC under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India
**School of Engineering**

**M.E. Computer Science and Engineering**

**Programme Specific Outcomes:**

**PSO 1:** Gain Knowledge in diverse areas of Computer Science and Engineering for the successful career, entrepreneurship and higher studies.

**PSO 2:** Analyse and apply mathematical models to find solutions for various hardware and software issues in the design and maintenance of computer systems.

**Scheme of Instruction & Examination**
(For students admitted from 2019-20 and onwards)

| *Part* | *Course Code* | *Name of Course / Component* | *Hours of Instruction /week* | | *Scheme of Examination* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **T** | **P** | *Duration of exam* | *CIA* | | *CE* | | *Total* | *Credits* |
| | | | | | | **T** | **P** | **T** | **P** | | |
| **First Semester** | | | | | | | | | | | |
| **I** | **Core Courses (CC)** | | | | | | | | | | |
| | 19MEOC01 | Mathematical Foundations of Computer Science | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOC02 | Advanced Data Structures | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOC03 | Advanced Data Structures Practicals | - | 3 | 3 | - | 40 | - | 60 | 100 | 1.5 |
| | 19MEOC04 | Software Development Practicals | - | 3 | 3 | - | 40 | - | 60 | 100 | 1.5 |
| | 19MEOC05 | Research Methodology and IPR | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| **I** | **Program Electives (PE)** | | | | | | | | | | |
| | 19MEOE11/ 19MEOE12/ 19MEOE13 | Program Elective-I | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOE21/ 19MEOE22/ 19MEOE23 | Program Elective –II | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| **II** | **Non Credit Mandatory Courses (NCMC)** | | | | | | | | | | |
| | **Audit Course (AC)** | | | | | | | | | | |
| | 19MEMA11/ 19MEMA12 | Audit Course- I | 3 | - | 2 | 100 | - | - | - | 100 | Remark |
| | **Extracurricular Course (ECC)** | | | | | | | | | | |
| | | CSS | 2 | - | - | - | - | - | - | - | - |
| **Program Elective-I:** 19MEOE11 Machine Learning/19MEOE12 Wireless Sensor Networks/ 19MEOE13 Software Engineering Methodologies | | | | | | | | | | | |
| **Program Elective-II:** 19MEOE21 Data Science/19MEOE22 Distributed Computing/ 19MEOE23 High Performance Networks | | | | | | | | | | | |

| *Part* | *Course Code* | *Name of Course / Component* | *Hours of Instruction /week* | | *Scheme of Examination* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **T** | **P** | *Duration of exam* | *CIA* | | *CE* | | *Total* | *Credits* |
| | | | | | | **T** | **P** | **T** | **P** | | |
| **Second Semester** | | | | | | | | | | | |
| **I** | **Core Courses (CC)** | | | | | | | | | | |
| | 19MEOC06 | Advanced Algorithms | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOC07 | Soft Computing | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOC08 | Soft Computing Practicals | - | 3 | 3 | - | 40 | - | 60 | 100 | 1.5 |
| | 19MEOC09 | Cloud Computing Practicals | - | 3 | 3 | - | 40 | - | 60 | 100 | 1.5 |
| | 19MEOC10 | Mini Project with Seminar | - | 2 | - | - | 100 | - | - | 100 | 1 |
| **I** | **Professional Certification Course (PCC)** | | | | | | | | | | |
| | 19MEOP01 | Professional Certification Course | - | - | - | 100 | - | - | - | 100 | 2 |
| **I** | **Program Electives (PE)** | | | | | | | | | | |
| | 19MEOE31/ 19MEOE32/ 19MEOE33 | Program Elective -III | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| | 19MEOE41/ 19MEOE42/ 19MEOE43 | Program Elective-IV | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| **II** | **Non Credit Mandatory Courses (NCMC)** | | | | | | | | | | |
| | **Audit Course(AC)** | | | | | | | | | | |
| | 19MEMA21/ 19MEMA23 | Audit Course-II | 3 | - | 2 | 100 | - | - | - | 100 | Remark |
| | **Extracurricular Course (ECC)** | | | | | | | | | | |
| | 19MECS01 | CSS | 2 | - | 2 | 50 | 50 | - | - | 100 | Remark |
| | **Internship during summer vacation for one month** | | | | | | | | | | |

**Program Elective -III:** 18MEOE31 Advanced Operating Systems/18MEOE32 Advanced Database /18MEOE33 Internet of Things

**Program Elective-IV:** 18MEOE41/ Information Security/ 18MEOE42 Computational Intelligence / 18MEOE43 Software Quality Management

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **I** | **Core Courses (CC)** | | | | | | | | | | |
| | 19MEOC11 | Dissertation-I | - | 20 | - | - | 100 | - | - | 100 | 10 |
| | 19MEOC12 | Internship | - | - | - | 100 | - | - | - | 100 | 1 |
| **I** | **Program Electives (PE)** | | | | | | | | | | |
| | 19MEOE51/ 19MEOE52/ 19MEOE53 | Program Elective-V | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |
| **I** | **Open Electives (OE)** | | | | | | | | | | |
| | 19MEBO01/ 19MELO01/ 19MEFO01 | Open Elective | 4 | - | 3 | 40 | - | 60 | - | 100 | 4 |

**Program Elective- V:** 19MEOE51 Mobile Application Development/19MEOE52 Cloud Computing/19MEOE53 Compiler Design

**Open Electives:** 19MEOE01 Quality Assurance and Safety in Hospitals/19MELO01Waste to Energy/19MEFO01 Industrial Safety and GMP in Food Industries

| *Part* | *Course Code* | *Name of Course / Component* | *Hours of Instruction /week* | | *Scheme of Examination* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fourth Semester** | | | | | | | | | | | |
| | | | **T** | **P** | ***Duration of exam*** | ***CIA*** | | ***CE*** | | ***Total*** | ***Credits*** |
| | | | | | | **T** | **P** | **T** | **P** | | |
| **I** | **Core Courses (CC)** | | | | | | | | | | |
| | 19MEOC13 | Dissertation-II | 32 | - | | 200 | | 200 | | 400 | 16 |
| | | | | | | | | | | **Total credits** | **80** |

**Total credits required to earn the degree: 80 and successful completion of Non-Credit Mandatory Courses**

**Other Courses to be undergone by the Students: MOOC Course - 2 Credits**

**List of Program Electives (PE)**

| S. No. | Course Code | Course Title |
|---|---|---|
| 1. | 19MEOE11 | Machine Learning |
| 2. | 19MEOE12 | Wireless Sensor Networks |
| 3. | 19MEOE13 | Software Engineering Methodologies |
| 4. | 19MEOE21 | Data Science |
| 5. | 19MEOE22 | Distributed Computing |
| 6. | 19MEOE23 | High Performance Networks |
| 7. | 19MEOE31 | Advanced Operating Systems |
| 8. | 19MEOE32 | Advanced Databases |
| 9. | 19MEOE33 | Internet of Things |
| 10. | 19MEOE41 | Information Security |
| 11. | 19MEOE42 | Cloud Computing |
| 12. | 19MEOE43 | Software Quality Management |
| 13. | 19MEOE51 | Mobile Application Development |
| 14. | 19MEOE52 | Computational Intelligence |
| 15. | 19MEOE53 | Compiler Design |

**Open Elective (OE) offered by CSE department**

| S. No. | Course Code | Course Title |
|---|---|---|
| 1. | 19MEOO01 | Web Mining |

**List of Audit Courses (Non-Credit Mandatory Course)**

| S. No. | Course Code | Audit Course -I |
|---|---|---|
| 1. | 19MEMA11 | English for Research Paper Writing |
| 2. | 19MEMA12 | Disaster Management |

| S. No. | Course Code | Audit Course- II |
|---|---|---|
| 1. | 19MEMA21 | Pedagogy Studies |
| 2. | 19MEMA23 | Stress Management by Yoga |

***Any one Course by MOOC from Swayam (NPTEL)**

| S. No. | Course Code | Course Title |
|---|---|---|
| 1. | 19MEOMC1 | MOOC (Title of the Course completed with certificate) |

## M.E Computer Science and Engineering

**Program Outcomes:**

**PO1:** Ability to apply knowledge of recent computing technologies and tools for solving engineering problems.

**PO2:** Ability to identify, analyze and interpret data and knowledge.

**PO3:** To have knowledge of contemporary researches issues and conduct investigations on complex problems in the area of Computer Science and Engineering.

**PO4:** Ability to explore the research gaps and carry out research in emerging areas of Computer Science and Engineering.

**PO5:** Ability to utilize latest software tools and techniques in Computer Science and Engineering to solve complex engineering problems.

**PO6:** To identify the problems of economic, environmental and societal problems and apply computer knowledge and innovations to generate solutions.

**PO7:** Ability to apply innovative solutions for environmental issues for sustainable development.

**PO8:** Able to function professionally with ethical responsibilities.

**PO9:** Ability to function efficiently as individual member or a leader of a team with positive attitude to achieve common goals.

**PO10:** Communicate efficiently with the engineering community and society to work in multi-disciplinary and multi-cultural environment.

**PO11:** To be proficient in project management techniques, tools and practices to plan manage and complete the project.

**PO12:** Ability to appreciate the importance of research work and to recognize the need for lifelong learning.

**Mathematical Foundations of Computer Science**

**Semester I** **Hours of Instruction/ week: 4T**

**19MEOC01** **No. of Credits: 4**

**Objective:**

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.

**Unit I Introduction**

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 **12**

**Unit II Random Distributions**

Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood. **12**

**Unit III Introduction to multivariate statistical models**

Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** the problem of over fitting model assessment. **12**

**Unit IV Graph Theory**

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 **12**

**Unit V 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. Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision **12**

**Total Hours: 60**

**References:**


1. ***John Vince, Foundation Mathematics for Computer Science (2015)***, Springer.
2. ***K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications(2001)***. Wiley.
3. ***M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysi (2005).***
4. ***Alan Tucker, Applied Combinatorics(2012)***, *6th edition.* Wiley


**Course Outcomes:**

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

**CO1:** Understand the basic notions of discrete and continuous probability

**CO2:**Understand the methods of statistical inference, and the role that sampling distributions play in those methods

**CO3:**Perform correct and meaningful statistical analyses of simple to moderate complexity

**CO4:**Expose to special classes of graphs

**CO5:**Apply Computer science and engineering in various fields

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | L | - | - | - | - | - | - | - | - | M |
| CO2 | H | M | L | - | - | - | - | - | - | - | - | M |
| CO3 | H | M | L | - | - | - | - | - | - | - | - | M |
| CO4 | H | M | M | - | - | - | - | - | - | - | - | M |
| CO5 | H | M | M | - | - | - | - | - | - | - | - | M |

## Advanced Data Structures

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOC02** **No. of Credits: 4**

**Objective:**

To select and design data structures that is appropriate for problems

**Unit I Introduction**

Abstract Data Types - Time and Space Analysis of Algorithms - Big Oh and Theta Notations – Average, best and worst case analysis- Simple recurrence relations and use in algorithms – Mappings- Real time applications. **12**

**Unit II Advanced Data Structures**

Red - Black Trees - properties and operations of red-black trees B-trees: definition of B-Tree- basic operations on B-Tree - Binomial heaps- operations on binomial heaps, Fibonacci heaps- operations on Fibonacci heaps. **12**

**Unit III Algorithm Design Techniques**

Dynamic Programming- elements of dynamic programming, -optimal binary search trees - Greedy Algorithms - elements of greedy strategy-Huffman codes, Amortized Analysis- aggregate analysis, the accounting method, the potential method**.** **12**

**Unit IV Graph Algorithms**

Minimum Spanning Trees- growing a minimum spanning tree, the algorithms of Kruskal and Prim, Single-source shortest paths-the Bellman- Ford algorithm - Dijkstra's algorithm, all pair shortest paths-shortest path and matrix multiplication, the Floyd-Warshall algorithm – Implementation and applications**.** **12**

**Unit V Parallel and Distributed Algorithms**

Parallel Algorithms: Basic Techniques- Work & Efficiency - Distributed Computation – Heuristic & Approximation Approaches**.** **12**

**Total Hours: 60**

**References:**


1. ***Mark Allen Weiss (2014). Data Structures and Algorithm Analysis in C++.*** Second Edition,Pearson Education, Asia.
2. ***Narasimha Karumanchi (2018). Algorithm Design Technique.*** Careeer Monk Publication.
3. ***Anany Levitin(2017). Introduction to the Design and Analysis of Algorithms.*** Pearson.
4. ***Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein (2011). Introduction to Algorithms***, Third Edition, Prentice-Hall.
5. ***Michael T. Goodrich, Roberto Tamassia, David M. Mount (2010). Data Structures and Algorithms in C++.*** Second Edition, University Press.


**Course Outcomes:**

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

**CO1:** Understand the complexities of the algorithms and mathematical relations.
**CO2:** Apply hierarchical data structures for solving problems.
**CO3:** Apply suitable design strategy for problem solving
**CO4:** Implement graph algorithms for solving computing problems.
**CO5:** Analyze parallel and distributed algorithms.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | H | - | L | - | - | - | - | M |
| CO2 | H | M | - | - | H | - | - | - | - | - | - | M |
| CO3 | H | M | L | - | M | - | L | - | - | - | - | L |
| CO4 | H | M | - | - | M | - | - | - | - | - | - | M |
| CO5 | M | H | - | - | - | - | H | - | - | - | - | L |

## Advanced Data Structures Practicals

**Semester I** **Hours of Instruction/ week :3P**
**19MEOC03** **No. of Credits: 1.5**

**Objective:**
To implement the concepts of data structures and problem solving strategies

**Data structures using C, C++ and java**

1. Implementation of insertion and deletion in Binary Search Tree.
2. Implementation of insertion and deletion in Red-Black Trees.
3. Implementation of Recursive and Iterative Greedy algorithm.
4. Implementation and correctness of Huffman's Algorithm.
5. Implementation of insertion, deletion & searching from a B-Tree.
6. Implementation of Heap operations.
7. Implement the Applications of Graphs.
8. Implementation of divide and conquer algorithm.
9. Implementation of branch and bound.
10. Implementation of AVL rotations.

**Total Hours: 45**

**References:**


1. ***Narasimha Karumanchi (2018). Algorithm Design Technique.*** CareeerMonk Publication.
2. ***Anany Levitin(2017). Introduction to the Design and Analysis of Algorithms*.** Pearson.
3. ***S.Sridhar (2014).Design and Analysis of Algorithms***. First Edition. Oxford University Press.


**Course Outcomes:**

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

**CO1:** Develop operation like insertion, deletion and searching Mechanism in trees
**CO2:** Have practical Knowledge on heap concepts.
**CO3:** Develop programs using graph algorithm techniques

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | - | H | M | - | - | - | - | - | - |
| CO2 | H | M | - | - | H | M | - | - | - | - | - | - |
| CO3 | M | H | - | - | M | M | - | - | | - | - | - |

## Software Development Practicals

**Semester I** **Hours of Instruction/ week: 3P**
**19MEOC04** **No. of Credits: 1.5**

**Objective:**

To impart knowledge on the concepts of Software engineering and develop practical applications

Implementations of application systems like:

1. Banking Management systems
2. Hospital Management System
3. Library Management System
4. Reservation system
5. Resource Management System
6. E-Learning
7. E-Commerce
8. Management Information system

**Total Hours: 45**

**References:**


1. ***Roger S. Pressman (2014). Software Engineering: A Practitioner Approach.*** Seventh Edition. McGraw-Hill.
2. ***Sommerville.I (2011). Software Engineering.*** Ninth Edition. Addison Wesley.
3. ***Len Bass, Ingo Weber and Liming Zhu (2016). DevOps: A Software Architect's Perspective***. Pearson Education.
4. ***Stephen R.Schach (2012). Software Engineering.*** *Seventh Edition.* Tata McGraw Hill.


**Course Outcomes:**

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

CO1: Understand the different process models in software engineering concepts
CO2: Develop practical applications for different scenario
CO3: Provide a scope to students to solve simple real life problems.

**CO- PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | M | - | - | - | - | - | - | - | - | - | - |
| CO2 | H | - | - | - | M | - | - | - | - | - | - | - |
| CO3 | M | M | M | - | - | - | L | - | - | - | - | - |

## Research Methodology and IPR

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOC05/19MEMC05/19MEFC0519MEVC05** **No. of Credits: 4**

**Objective:**

To introduce the concept of Scientific Research and its processes and intellectual property rights.

**Unit I Introduction**

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 **12**

**Unit II Literature Survey**

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee **12**

**Unit III Intellectual Property Rights**

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. **12**

**Unit IV Patent Rights**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **12**

**Unit V New Development in IPR**

Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. **12**

**Total Hours: 60**

**References:**


1. ***Stuart Melville and Wayne Goddard*****,** "***Research methodology: An introduction for science & engineering students*****",** Juta &Co Ltd, 1996.
2. ***Wayne Goddard and Stuart Melville***, "***Research Methodology: An Introduction*****",** Juta and company Ltd 2004.
3. ***Ranjit Kumar,* "*Research Methodology: A Step by Step Guide for beginners" 3rd Edition,*** *SAGE publications Ltd, 2014.*
4. ***Halbert,*** "***Resisting Intellectual Property***", Taylor & Francis Ltd, 2007.
5. ***Mayall,* "*Industrial Design*",** McGraw Hill, 2002.
6. ***Niebel,*** "***Product Design***", McGraw Hill, 2005.
7. ***Asimov*****, "*Introduction to Design*",** Prentice Hall, 2000.
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

**Course Outcomes:**

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

CO1 : Outline the research problem.

CO2 : Formulate the problem statement and prepare research plan for the problem under investigation

CO3 : Discuss the Indian and International Intellectual Property Rights

CO4 : Describe the patent rights

CO5 : Discuss new developments in IPR

**CO- PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | H | H | M | - | - | - | M | - | H | M |
| CO2 | - | M | H | H | - | - | - | - | M | - | H | L |
| CO3 | M | - | H | M | - | - | - | H | M | - | - | M |
| CO4 | - | - | H | - | - | - | - | H | - | - | H | M |
| CO5 | - | M | - | - | M | - | - | - | - | M | - | M |

## Advanced Algorithms

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOC06** **No. of Credits: 4**

**Objective:**

To study the advanced methods of designing, analyzing algorithms and use it for a specific problem.

**Unit I Sorting and Graph**

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 **12**

**Unit II Matroids and Graph Matching**

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 **12**

**Unit III Flow Networks and Matrix Computations**

Flow-Networks - Maxflow- mincut theorem - Ford-Fulkerson Method to compute maximum flow - Edmond-Karp maximum-flow algorithm - Matrix Computations -Stassen'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. **12**

**Unit IV Shortest Path in Graphs**

Shortest Path in Graphs-Floyd - Warshall algorithm and introduction to dynamic programming paradigm - Modulo Representation of integers/polynomials - Chinese Remainder Theorem - Conversion between base-representation and modulo-representation -Extension to polynomials - Application: Interpolation problem **12**

**Unit V Linear Programming**

Linear Programming-Geometry of the feasibility region and Simplex algorithm NP-completeness-Examples - proof of NP-hardness and NP-completeness - Approximation algorithms, Randomized Algorithms, -Interior Point Method. **12**

**Total Hours: 60**

**References:**


1. ***Anany Levitin (2014). Introduction to the Design and Analysis of Algorithms.*** Pearson Education
2. ***Dexter C. Koze (2012). The Design and Analysis of Computer Algorithms***. Springer.
3. ***Kleinberg and Tardos (2013). Algorithm Design.***Pearson Education.

**Course Outcomes:**

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

**CO1:** Understand the different sorting algorithms and graph problems.

**CO2:** Analyze the matroids and graph matching algorithms for solving a particular set of problems.

**CO3:** Understand the concepts of flow networks and matrix computations

**CO4:** Know an insight of recent activities in the field of the advanced data structure.

**CO5:** Understand the ways to analyze linear programs.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | M | - | - | - | - | - | - | - |
| CO2 | H | - | M | - | M | M | - | - | - | - | - | L |
| CO3 | M | - | H | - | M | M | - | - | - | - | - | M |
| CO4 | - | M | M | - | - | - | - | - | - | - | M | M |
| CO5 | M | H | - | - | M | - | - | - | - | - | - | - |

## Soft Computing

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOC07** **No. of Credits: 4**

**Objective:**

To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.

**Unit I Introduction to Soft Computing and Neural Networks**

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics. **12**

**Unit II 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 **12**

**Unit III 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 **12**

**Unit IV Genetic Algorithms**

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition **12**

**Unit V 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 **12**

**Total Hours: 60**

**References:**


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


**Course Outcomes:**

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

**CO1:** Identify the basics of soft computing techniques and also their use in some real life situations.

**CO2:** Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems

**CO3:** Architectural Design for various neural networks techniques.

**CO4:** Apply different fuzzy logic techniques and genetic algorithms Apply genetic algorithms to combinatorial optimization problems.

**CO5:** Implement the various soft computing techniques using MATLAB/ Python.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | M | - | - | M | - | H | M | - | H | - | L |
| CO2 | H | - | M | - | H | M | - | - | - | - | - | - |
| CO3 | - | H | - | - | H | - | - | - | - | - | - | - |
| CO4 | H | - | M | - | H | M | - | - | - | - | - | - |
| CO5 | M | - | M | - | H | - | - | - | - | - | - | - |

## Soft Computing Practicals

**Semester II** **Hours of Instruction/ week: 3P**
**19MEOC08** **No. of Credits: 1.5**

**Objective:**

To apply the soft computing techniques to solve logical functions using MATLAB.

**List of Experiments:**

1. To perform union, Intersection and complement operations.
2. To implement De Morgan's Law.
3. To plot various membership functions.
4. Implement FIS Editor.
5. Implementation of Fuzzy Operations
6. Implementation of Fuzzy Relations (Max-min Composition)
7. Implementation of Fuzzy Controller (Washing Machine)
8. Implementation of Simple Neural Network (McCulloh-Pitts model)
9. Implementation of Perceptron Learning Algorithm
10. Calculate the weights for given patterns using hetero-associative neural net.
11. Implementation of Simple Genetic Application
12. Implement TSP using GA.

**Total Hours: 45**

***References:***


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


**Course Outcomes:**

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

**CO1**: Analyze the applications which can use fuzzy logic.
**CO2:** Understand the difference between learning and programming and explore practical applications of Neural Networks
**CO3:** Understand the basics of genetic algorithm, use of GA operators and its applications

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | H | - | - | - | - | - | - | L |
| CO2 | M | H | - | - | H | - | - | - | - | - | - | - |
| CO3 | M | H | - | - | H | - | - | - | - | - | - | - |

## Cloud Computing Practicals

**Semester II** **Hours of Instruction/ week: 3P**
**19MEOC09** **No. of credits: 1.5**

**Objective:**
To understand the cloud environment and implement virtualization using simulation software**.**

**List of Experiments:**

1. Installation and configuration of Vsphere on VMware/eucalyptus.
2. Creating VM of different configuration using Vsphere.
3. Configure VM on Eucalyptus.
4. Attach Virtual block to virtual machine for holding data.
5. Managing cloud computing resources.
6. Case study: Google App Engine- Microsoft Azure.
7. Case study: PAAS (Facebook- Google App engine).
8. Case study on torrent cloud.

**Total Hours: 45**

**References:**


1. ***David E.Y. Sarna (2011).Implementing and Developing Cloud Application***.CRC press.
2. ***Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas (2011).NIST Draft cloud computing synopsis and recommendation.***


**Course Outcomes:**
At the end of the course, students will be able to

**CO1:** Create virtual machines of different configuration
**CO2:** Acquire knowledge on various cloud environment
**CO3**: Develop and deploy cloud application using popular cloud platforms

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | M | M | - | - | - | - | - | - | - | - | - | - |
| **CO3** | M | L | - | - | - | - | - | - | - | - | - | - |

## Machine Learning

**PE I**
**Semester I** **Hours of Instruction/ week: 4T**
**19MEOE11** **No. of Credits: 4**

**Objective:**
To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.

**Unit I Supervised Learning (Regression/Classification)**
Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive BayesLinear models: Linear Regression, Logistic Regression, and Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods beyond Binary Classification: Multi-class/Structured Outputs, Ranking. **12**

**Unit II 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). **12**

**Unit III Machine Learning algorithms and Model Selection**
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, and Random Forests), Sparse Modelling and Estimation, Modelling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning. **12**

**Unit IV Scalable Machine Learning**
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. **12**

**Unit V Applications in Recent Trends**
Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications. **12**

**Total Hours: 60**

**References:**

1. ***Kevin Murphy (2012). Machine Learning: A Probabilistic Perspective.*** MIT Press.
2. ***Trevor Hastie, Robert Tibshirani, Jerome Friedman (2013). The Elements of Statistical Learning.*** Springer (freely available online).
3. ***Christopher Bishop (2016). Pattern Recognition and Machine Learning.*** Springer.


**Course Outcomes:**
At the end of the course, students will be able to

**CO1:**Analyse the features that can be used for a particular machine learning approach in supervised learning.
**CO2:** Identify the concepts of machine learning approach in Unsupervised learning.
**CO3:** 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.
**CO4:** Apply mathematically various machine learning approaches and paradigms.
**CO5:** Apply the concepts of machine learning applications.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | M | - | M | - | - | - | - | - | - | L |
| CO2 | - | H | - | - | M | - | - | - | - | - | - | L |
| CO3 | H | M | M | - | H | - | - | - | - | - | - | - |
| CO4 | H | M | - | - | - | - | - | - | - | M | - | - |
| CO5 | - | M | - | - | H | - | - | - | - | M | - | - |

## Wireless Sensor Networks

**PE I**

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOE12** **No. of Credits: 4**

**Objective:**
To understand the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.

**Unit I 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 **12**

**Unit II Introduction to ns-3**
**I**ntroduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example. **12**

**Unit III 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) **12**

**Unit IV Security** **12**
Possible attacks, countermeasures, SPINS, Static and dynamic key distribution

**Unit V 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. Recent development in WSN standards, software applications. **12**

**Total Hours: 60**

**References:**


1. ***W. Dargie and C. Poellabauer (2010). Fundamentals of Wireless Sensor Networks – Theory and Practice.*** Wiley.
2. ***KazemSohraby, Daniel Minoli and TaiebZnati (2015). Wireless sensor networks - Technology, Protocols, and Applications.*** Wiley Inter science.
3. ***Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann (2010). Wireless Sensor Network Technologies for the Information Explosion Era.*** Springer.

**Course Outcomes:**

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

**CO1:** Describe and explain radio standards and communication protocols for wireless sensor networks.

**CO2:** Explain the function of the node architecture and use of sensors for various applications.

**CO3:** Understand the architectures, functions and performance of wireless sensor networks systems and platforms.

**CO4:** Understand High levels of technical competence in the field.

**CO5:** Apply problem solving approaches to work challenges and make decisions using sound engineering methodologies.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | H | -- | - | M | - | - | H | - | - | - | - |
| CO2 | - | H | - | - | M | - | M | - | - | - | - | - |
| CO3 | - | M | - | - | M | - | - | - | - | - | L | - |
| CO4 | - | M | - | - | H | - | M | - | - | - | - | - |
| CO5 | - | M | - | - | - | - | - | - | - | - | - | L |

## Software Engineering Methodologies

**PE I**

**Semester I** **Hours of Instruction/ week: 4T**

**19MEOE13** **No. of Credits: 4**

**Objective:**

To gain knowledge about software process, project management and about software quality assurance based on technical reviews, configuration management

**Unit I Process and Project Management**

Software Process models – process iteration – process activities – rational unified process – computer aided software engineering- Management activities – project planning – project scheduling – risk management. **12**

**Unit II Requirement Analysis**

Functional and Non – functional requirements – user requirements – system requirements – interface specifications – software requirements document. Requirements engineering processes – feasibility studies – elicitation and analysis – validations – management. System Models – Context – Behavioral – Data – Object – Structured. **12**

**Unit III Software Design**

Architectural Design – Distributed System Architectures – Application Architectures – Object Oriented Design **(Self Study)** – Real-time Software Design. **12**

**Unit IV Software Testing**

Software testing fundamentals – Test Case Design – White Box – Basis Path Testing – Control Structure Testing – Black Box – Testing for Specialized environments, Architectures and Applications - Software Testing Strategies – Approach– issues – testing – unit – integration – validation – system – art of debugging. **12**

**Unit V Software Quality Assurance**

Software Quality Concepts – Quality Assurance – Software Technical Reviews – Formal Approach to Software Quality Assurance – Reliability – Quality Standards – Software Quality Assurance Plan – Software Maintenance – Software Configuration Management – configuration item – process – objects in the software configuration – version control – change control – configuration audit – status reporting – SCM Standards . **12**

**Total Hours: 60**

**References:**


1. ***Roger S. Pressman (2010). Software Engineering: A Practitioner's Approach.*** Sixth Edition, McGraw Hill.
2. ***I.Sommerville (2011). Software Engineering.*** *Ninth* Edition, Addison Wesley.
3. ***Daniel Galin (2009). Software quality assurance –from theory to implementation.*** Pearson education.
4. ***Yogesh Singh (2012). Software Testing.*** Cambridge University Press.
5. ***Paul C. Jorgensen (2006). Software testing – Crafts man approach. Third Edition.*** *Auerbach Publications.*

**Course Outcomes:**

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

**CO1:** Understand the different Process models and project management activities

**CO2:**Analysis the user requirements and develop a modeling concepts

**CO3:**Demonstrate an application software by applying various software design concepts

**CO4:**Apply various software testing methods and develop a software product

**CO5:**Examine the quality of the software by reviewing the software and managing particular software to be assured.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | H | - | - | - | - | L | - | - |
| CO2 | M | H | - | - | H | - | - | - | - | L | - | - |
| CO3 | M | H | M | - | H | M | - | - | - | - | - | - |
| CO4 | M | - | - | - | H | - | - | - | - | M | - | - |
| CO5 | M | H | M | - | H | M | - | - | - | - | - | - |

## Data Science

**PE II**

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOE21** **No. of Credits: 4**

**Objective:**

To provide you with the knowledge and expertise to become a proficient data scientist.

**Unit I Introduction**

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications. **12**

**Unit II Data Management**

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data Sources. **12**

**Unit III Data Analysis**

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. **12**

**Unit IV Data Visualisation**

Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings. **12**

**Unit V Applications of Data Science**

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. **12**

**Total Hours: 60**

**References:**


1. ***Lars Nielsen,Noreen Burlingame (2015).A Simple Introduction to Data Science.*** First edition. New Street
2. ***Jeffrey Stanton (2013). Introduction to Data Science.*** Syracuse University.


**Course Outcomes:**

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

**CO1:** Explain how data is collected, managed and stored for data science.
**CO2:**Develop the skills related to data management.
**CO3:**Apply proficiency with statistical analysis of data.
**CO4:**Understand the different concepts in data visualization.
**CO5:** Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | M | - | M | - | - | M | - | - |
| CO2 | - | M | - | - | M | - | - | M | - | L | - | - |
| CO3 | M | H | - | - | M | - | - | M | - | - | - | - |
| CO4 | M | H | L | - | L | - | - | - | - | - | - | - |
| CO5 | M | - | - | - | - | M | L | - | - | - | - | M |

## Distributed Computing

**PE II**

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOE22** **No. of Credits: 4**

**Objective:**

To study about various concepts of process and resource management in distributed computing environment.

**Unit I Introduction**

Introduction to System models- Design issues of distributed operating systems – Distributed Computing environment. **12**

**Unit II Communication**

Message Passing: Features and Issues– Synchronization-Buffering – Process addressing – Failure handling- Remote Procedure Call: Model – Implementation –Stub generation –RPC messages- Marshalling –Server management-Call semantics – Distributed shared memories – Architecture and design issues. **12**

**Unit III Synchronization and Transactions**

Introduction - Clock synchronization -Physical clocks- Logical clocks- Election algorithms- Mutual exclusion – Deadlocks - Transaction model- Classification – Implémentation – Concurrency control. **12**

**Unit IV Process and Resource Management**

Process migration: Features– Mechanism –Threads: Models, Issues, Implementation - Features-Task assignment approach–Load Balancing approach–Load sharing approach. **12**

**Unit V Naming Services**

Names, Identifiers and Addresses- Name resolution- Name space implementation- Domain Name System- Name Caches-Security - CASE STUDY: DFS – features, models, file sharing semantics, file replication and fault tolerance - Introduction to Hadoop, HDFS Architecture, Setting up the Hadoop environment, Map-Reduce Architecture, Map Reduce Programming - Advanced Features – Hbase, Pig, Zookeeper, Managing a Hadoop cluster. **12**

**Total Hours: 60**

**References:**


1. ***Pradeep K Sinha (2015). Distributed Operating Systems: Concepts and Design.*** PHI / Prentice Hall of India.New Delhi.
2. ***George Coulouris ,Jean Dollimore , Tim Kindberg and Gordon Blair(2012). Distributed systems : Concepts and Design.*** Fifth Edition. Pearson Education.
3. ***Andrew S Tanenbaum and Marteen van steen(2016). Distributed Systems Principles and Paradigms.*** Createpsace Independent Publishing Platform.

**Course Outcomes:**

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

**CO1:** Understand the concepts that underlie distributed computing systems along with design and implementation issues.

**CO2:** Acquire knowledge on the process of communication and interconnection architecture of multiple computer systems.

**CO3:** Analyse and understand the concepts of synchronization of clocks and deadlocks.

**CO4:** Understand the concepts of process and resource management in distributed computing environment

**CO5:** Analyse and compare various naming services and an overview of Hadoop environment in distributed computing.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | M | L | - | - | - | - | - | - |
| CO2 | M | M | - | - | M | - | - | - | - | L | - | - |
| CO3 | M | H | - | - | M | L | - | - | - | - | - | |
| CO4 | M | H | - | - | M | L | - | - | - | - | - | - |
| CO5 | M | H | M | - | L | - | - | - | - | L | - | - |

## High Performance Networks

**PE II**

**Semester I** **Hours of Instruction/ week: 4T**
**19MEOE23** **No. of Credits: 4**

**Objective:**

To demonstrate the knowledge of network communication and to optimize performance of high-speed networks

**Unit I High Speed Networks**

Introduction to high speed networks-High speed LANS- Fast Ethernet-Gigabit Ethernet- Fibre Channel-Frame Relay Networks-Packet Switching Vs. frame relay Networks**.** **12**

**Unit II Asynchronous Transfer Mode and Sonnet**

ATM Protocol Architecture, ATM logical Connection – ATM Cell – ATM Service Categories – AAL- Introduction to SONET –SONET/SDH layers – SONET Frame Structure – SONET Physical Layer**.** **12**

**Unit III ATM Congestion Control and Traffic Management**

Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work**–** Traffic Control – ABR traffic Management – ABR rate control, RM cell formats – ABR Capacity allocations – GFR traffic management – Congestion Control in Packet Switching Networks – Frame relay congestion. **12**

**Unit IV Protocols for QoS Support**

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, and Protocol details – RTP –Protocol Architecture, Data Transfer Protocol, RTCP. **12**

**Unit V Design Techniques**

Design principles and tradeoffs-End-to-End Vs. Hop-by-Hop-Control Mechanisms –Design techniques-Scaling time and space-specialized hardware implementation- parallelism and pipelining-data structure optimization –latency reduction. Future trends: Changing resource tradeoffs – technology and applications. **12**

**Total Hours: 60**

**References:**


1. ***Larry Peterson and Bruce Davie (2011). Computer Networks: A Systems Approach.*** 5th edition, Morgan Kauffman.
2. ***BehrouzA.Forouzan (2017).Data Communications and Networking.*** 5th Edition. Tata McGraw-Hill
3. ***William Stallings (2012). High-Speed Networks and Internets.*** 2nd Edition. Pearson Education
4. ***Warland, PravinVaraiya (2011). High performance Communication network.*** Morgan Kauffman- Harcourt Asia Pvt Ltd, Second Edition.

**Course Outcomes:**

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

**CO1:** Understand the various high speed digital access and broadband technologies.

**CO2:** Gain Knowledge about the ATM and Frame relay techniques used to support real-time application.

**CO3:**Design a network at a high-level using different networking technologies used in congestion control.

**CO4:** Learn about different levels of quality of service (QoS) to different design applications.

**CO5:**Design and configure network that have outcome characteristics needed to support a specified set of applications

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | H | M | - | M | - | - | - | - | L | - | - |
| CO2 | M | H | M | - | M | L | - | - | - | - | - | - |
| CO3 | - | H | M | | M | | - | - | - | L | - | - |
| CO4 | M | H | M | | M | L | - | - | - | L | - | - |
| CO5 | M | H | M | - | M | L | - | - | - | L | - | - |

## Advanced Operating Systems

**PE III**

**Semester II** **Hours of Instruction/ week: 4T**

**19MEOE31** **No. of Credits: 4**

**Objective:**

To learn advanced operating system design and concept of process, process lifecycle and scheduling approaches.

**Unit I Introduction**

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems. **12**

**Unit II Process**

Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and micro-kernels. **12**

**Unit III Scheduling**

Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, and mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies. **12**

**Unit IV Memory Management**

Memory management, Virtual memory concept, Virtual machines, I/O management, File and disk management, Operating system security. **12**

**Unit V Distributed Operating Systems**

Distributed Operating system: Architecture, Design issues, Distributed mutual exclusion, Distributed deadlock detection, shared memory, Distributed scheduling. Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance. **12**

**Total Hours: 60**

***References:***


1. ***M. Singhal, N.G. Shivratri (2009). Advanced concept in operating system. Tata Mc-Graw Hill***
2. ***William Stallings (2012). Operating system internal and design principles.*** Pearson Education.


**Course Outcomes:**

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

**CO1:** Understand advanced concepts in operating systems, issues and its types.
**CO2:** Ability to understand the process synchronization concepts.
**CO3:** Ability to acquire knowledge about various scheduling algorithms and deadlock system.
**CO4:** Ability to acquire knowledge about various memory management schemes
**CO5:** Understand the concepts of distributed operating systems and its issues.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | H | M | - | M | - | - | - | - | M | - | - |
| CO2 | M | H | M | - | L | - | - | - | - | L | - | - |
| CO3 | M | H | M | - | L | - | - | - | - | M | - | - |
| CO4 | L | H | M | - | M | - | - | - | - | M | - | - |
| CO5 | L | H | H | - | L | - | - | - | - | M | - | - |

## Advanced Databases

**PE III**

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOE32** **No. of Credits: 4**

**Objective:**
To provide an in-depth understanding of advanced concepts indifferent types of databases and its applications.

**Unit I Parallel and Distributed Databases**
Database System Architectures: Centralized and Client-Server Architectures– Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism –Distributed Database Concepts Distributed Data Storage – Distributed Transactions – Commit Protocols –Concurrency Control Distributed Query Processing – Three Tier Client Server Architecture. **12**

**Unit II Object and Object Relational Databases**
Concepts for Object Databases: Object Identity – Object structure – Type Constructors Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle **12**

**Unit III Emerging Systems**
Spatial - deductive databases- XML Databases: XML Data Model - DTD - XML Schema - XML Querying – Web Databases – JDBC – Information Retrieval – Data Warehousing – Data Mining**.** **12**

**Unit IV Mobile Databases**
Introduction to Mobile Databases- Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols- Mobile Database Recovery Schemes **.** **12**

**Unit V Multimedia Databases**
Multidimensional Data Structures – Image Databases – Text/Document Databases- Video Databases – Audio Databases – Multimedia Database Design. **12**

**Total Hours: 60**

**References:**


1. ***Henry F Korth, Abraham Silberschatz, S. Sudharshan (2011). Database System Concepts.*** Sixth Edition, McGraw Hill.
2. ***R. Elmasri, S.B. Navathe(2010). Fundamentals of Database Systems.*** Sixth Edition, Pearson Education/Addison Wesley.
3. ***Vijay Kumar (2016). Mobile Database Systems.*** John Wiley & Sons.
4. ***Thomas Cannolly and Carolyn Begg(2017).Database Systems, A Practical Approach to Design, Implementation and Management.*** Third Edition, Pearson Education.

**Course Outcomes:**

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

**CO1:** Acquire knowledge on parallel and distributed databases and its applications.

**CO2:** Understand the design of Object Relational Database in SQL/Oracle

**CO3:** Learn the concepts of emerging databases like Mobile, XML, and Cloud

**CO4:** Understand the usage and applications of Mobile Database and Mobility on Data Management

**CO5:** Develop the logical design of the Multimedia database using data modeling concepts.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | M | - | L | - | - | - | - | M | - | - |
| CO2 | L | H | M | - | L | - | - | - | - | M | - | M |
| CO3 | M | M | - | - | M | - | - | - | - | L | - | M |
| CO4 | L | H | M | - | L | - | - | - | - | M | - | M |
| CO5 | M | M | - | - | M | - | - | - | - | L | - | M |

## Internet of Things

**PE III**

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOE33** **No. of Credits: 4**

**Objective:**
To understand the fundamental concepts of Internet of Things in the real world scenario.

**Unit I Fundamentals of IoT**
Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoT – IoT vs. M2M. **12**

**Unit II IoT Design Methodology**
IoT systems management – IoT Design Methodology – Specifications Integration and Application Development. **12**

**Unit III Building IoT with Raspberry Pi**
Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services **12**

**Unit IV Building IoT with Galileo/Arduino**
Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks **12**

**Unit V Case Studies and Advanced Topics**
Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for IoT – Data Analytics for IoT – Software & Management Tools for IoT. **12**

**Total Hours: 60**

**References:**


1. ***ArshdeepBahga, Vijay Madisetti (2015). Internet of Things – A hands-on approach.*** Universities Press.
2. ***Manoel Carlos Ramon (2014). Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers.***
3. ***Marco Schwartz (2014). Internet of Things with the Arduino Yun.*** Packet Publishing.


**Course Outcomes:**
At the end of the course, students will be able to

**CO1:** Understand the basic concepts in IoT.

**CO2:** Develop web services to access/control IoT devices.

**CO3:** Deploy an IoT application using Raspberry Pi.

**CO4:** Design a portable IoT using Arduino/ equivalent boards.

**CO5:** Analyse applications of IoT in real time scenario

### CO-PO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | M | | M | | | | | L | | |
| CO2 | | H | | M | | | M | | | | | M |
| CO3 | M | M | | H | | | | L | M | | M | |
| CO4 | M | M | | H | | | | L | M | | M | |
| CO5 | | H | M | | M | | | L | | | M | |

## Information Security

**PE IV**

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOE41** **No. of Credits: 4**

**Objective:**

To learn about the principal concepts, legal and ethical issues in Information Security

**Unit I Introduction to Information Security**

Introduction – History – What is security? – Critical characteristics of Information – NSTISSC Security Model – Component of an Information System – Security Components – Approaches – System Development Life Cycle (SDLC)– Security SDLC. **12**

**Unit II Introduction to Need and Issues in Information Security**

Business Needs – Threats – Attacks – Secure Software Development –Law and Ethics Information Security – International Laws and Legal Bodies. **12**

**Unit III Risk Management**

Introduction –Overview of Risk Management – Risk Identification, Assessment –Risk Control Strategies and Practices. **12**

**Unit IV Security Technology**

Introduction – Physical Design – Firewall's – Protecting Remote Connection– Intrusion Detection and Prevention Systems. **12**

**Unit V Information Security Implementation and Maintenance**

Information Security Project Management – Technical Topics of Implementation – Non-Technical aspects of Implementation. **12**

**Total Hours: 60**

**References:**


1. ***Michael E.Whitman and Herbert J.Mattord (2012). Principles of Information Security.*** 5th Edition Thomson Course Technology.
2. ***Jason Andress (2014). The Basics of Information Security: Understanding the Fundamentals of InfoSec in Theory and Practice.*** 2nd Edition. Elsevier
3. ***Jonathan Spring and Timothy Shimeall (2014). Introduction to Information Security: A Strategic-Based Approach.*** 1st Edition. Elsevier
4. ***Nicki Krause, Harold F.Tipton (2016). Handbook of Information Security Management.*** Vol 1-3, CRC Press LLC.


**Course Outcomes:**

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

**CO1:** Develop an understanding of information assurance as practiced in computer operating Systems, distributed systems, networks and representative applications.

**CO2:** Gain familiarity with prevalent network and distributed system attacks, defenses against them and forensics to investigate the aftermath.

**CO3:** Develop a basic understanding of risk Management and risk control Strategies.

**CO4:** Understand the various security Technologies, how it has evolved with some detection and prevention techniques used today.

**CO5:** Develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | H | - | - | - | L | M | - | M | - |
| CO2 | M | H | M | - | L | - | - | - | - | M | - | - |
| CO3 | L | H | M | - | L | - | - | - | - | M | - | M |
| CO4 | M | M | - | - | M | - | - | - | - | L | - | M |
| CO5 | L | M | - | - | H | - | - | - | - | M | - | M |

## Cloud Computing

**PE IV**
**Semester II** **Hours of Instruction/ week: 4T**
**19MEOE42** **No. of Credits: 4**

**Objective:**
To know the overview concepts and processes in cloud services and virtual machines.

**Unit I Introduction to Cloud Computing**
Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing. **12**

**Unit II Cloud Computing Architecture**
Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in cloud computing environments, CPU Virtualization, A discussion on Hypervisors storage Virtualization, Cloud Computing Defined, The SPI Framework for Cloud Computing, The cloud services Delivery Model. Cloud Deployment Models-Key drivers to adopting the cloud, the impact of Cloud computing on Users, Governance in the cloud, and Barriers to cloud computing adoption in the Enterprise. **12**

**Unit III Security Issues in Cloud Computing**
Infrastructure Security, Infrastructure Security: The Network Level, the Host Level, the Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management - Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management. **12**

**Unit IV Security Management in the Cloud**
Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS, **Privacy Issues-** Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations. **12**

**Unit V Audit and Compliance**
Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud. **12**

**Total Hours: 60**

**References:**


1. ***Lizhe wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah (2017). Cloud Computing: Methodology, Systems and Applications. CRC Press***
2. ***Vic (J.R) Winkler (2011). Securing the Cloud: Cloud Computer Security Techniques and Tactics.*** *Elsevier*.
3. ***Judith Hurwitz, Robin Bloor, Marcia Kaufman and Dr. Fern Halper (2010). Cloud Computing for Dummies.*** Wiley Publishing.

**Course Outcomes:**

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

**CO1**: Understand the basic concepts in cloud.

**CO2**: Summarize the cloud computing architecture and virtual machine concepts for different applications.

**CO3**: Identify security aspects of each cloud model.

**CO4**: Illustrate the concepts in security-management strategy for moving to the Cloud.

**CO5**: Implement a public cloud instance using a public cloud service provider

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | L | - | - | M | - | - | M | - | - |
| CO2 | M | M | - | - | H | - | | - | - | M | - | - |
| CO3 | M | H | - | M | - | - | M | - | - | L | - | - |
| CO4 | H | - | M | - | H | M | - | - | - | M | - | L |
| CO5 | M | - | H | - | - | - | L | - | - | L | - | - |

## Software Quality Management

**PE IV**

**Semester II** **Hours of Instruction/ week: 4T**
**19MEOE43** **No. of Credits: 4**

**Objective:**

To understand the terms and elements of software Quality Management and quality assurance for the growth of developing a software

**Unit I Introduction to Software quality**

Introduction- Quality and Software Quality - Views of Quality- Hierarchical Model - Hierarchical Models of Boehm and McCall - Quality Criteria Interrelate. **12**

**Unit II Software Quality Measures**

Measuring Quality - Software Metrics - Metrics cited in the Literature - The Problems with Metrics - Overall Measure of Quality- Developments in measuring quality - The work of Gilb - The COQUAMO Project - Recent Work on Metrics - Quality Profiles. **12**

**Unit III Software Quality Management**

Terms and Elements of Quality Management Systems (QMS)–Key to quality management-Quality in Software - The Problems of User Requirements - QMS for Software - Quality Assurance - Growth of Software Engineering Methods - CASE Tools - Methods and Tools to Quality - Alternative Approaches to Software Development **12**

**Unit IV Standards for Quality Management and Process Improvement**

The Purpose of Standards - The ISO9000 Series - ISO9000-3 - Impact of ISO9000- the Capability maturity model - Levels of CMM–Role of CMM - SPICE. **12**

**Unit V Trends in Quality**

Four key Issues in Quality–Process improvement for Software development - Impact of standards–Need for strategic view - Case studies. **12**

**Total Hours: 60**

**References:**


1. ***Alan C Gillies (2013). Software Quality Theory and Management.*** Thomson Asia, Second Edition.
2. ***Brooks F (2013). Software Quality Producing Practical Consistent Software.*** Thomson Asia.


**Course Outcomes:**

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

**CO1:** Understand about various software quality and views of quality models
**CO2:** Improve software quality based on software metrics and measures
**CO3:** Approach to manage good quality software by assuring the software
**CO4:** Understand the importance of standards in the quality management process and their process improvement in the final product
**CO5:** Understand about various trends in quality to improve software development process

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | - | - | L | - | - | M | - | - |
| CO2 | M | M | - | L | - | - | M | - | - | M | - | - |
| CO3 | M | M | | L | H | - | - | - | - | M | - | - |
| CO4 | M | - | - | - | H | - | - | H | - | L | - | - |
| CO5 | - | H | - | L | M | - | M | - | - | L | - | - |

## Mobile Application Development

**PE V**

**Semester III** **Hours of Instruction/ week: 4T**
**19MEOE51** **No. of Credits: 4**

**Objective:**
To know the components and structure of mobile application development frameworks for Android and windows OS based mobiles.

**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 **12**

**Unit II UI and Components**

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 **12**

**Unit III Network Connectivity**

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 **12**

**Unit IV Metrics**

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 **12**

**Unit V Hacking and Related Issues**

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. **12**

**Total Hours: 60**

**References:**


1. ***Wei-Meng Lee (2013). Beginning Android 4 Application Development.*** John Wiley & Son.
2. ***Reto Meier (2012).Professional Android 4 Application Development*** . John Wiley India
3. ***James C Sheusi (2013). Android Application Development for Java Programmers***. Cengage Learning

**Course Outcomes:**

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

**CO1:** Understand the basic concepts in Mobile application environment.

**CO2:** Understand the technologies and tools used in U.

**CO3:** Show the ability to analyze the features of network connectivity.

**CO4:** Solve the problems by implementing the metrics in Android.

**CO5:** Understand the technical issues related to hacking and various hacking techniques.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | - | - | L | - | - | M | - | - |
| CO2 | M | M | - | L | - | - | M | - | - | M | - | - |
| CO3 | M | M | - | L | H | - | - | - | - | M | - | - |
| CO4 | H | - | M | - | H | M | - | - | - | M | - | L |
| CO5 | M | - | H | - | - | - | L | - | - | L | - | - |

## Computational Intelligence

**PE V**

**Semester III** **Hours of Instruction/ week: 4T**
**19MEOE52** **No. of Credits: 4**

**Objective:**
To learn about introduction of evolutionary computation, Genetic Algorithm and Optimization techniques.

**Unit I Introduction**
Historical development of Evolutionary Computation (EC) – Features of EC – Classification of EC - Advantages – Applications. **12**

**Unit II Simulated Annealing**
Introduction – Annealing schedule – Pseudo code – Parameter selection – Applications **12**

**Unit III Genetic Algorithms**
Introduction – Biological Background – Operators in GA-GA Algorithm – Classification of GA – Applications**.** **12**

**Unit IV Ant Colony Optimization**
Introduction – From real to artificial ants- Theoretical considerations – Convergence proofs – principles of ACO-ACO Algorithm – ACO and model based search –Application . **12**

**Unit V Particle Swarm Optimization**
Introduction – Principles of bird flocking and fish schooling – Evolution of PSO – Operating principles – PSO Algorithm – Neighbourhood Topologies – Convergence criteria – Applications of PSO**.** **12**

**Total Hours: 60**

**References:**


1. ***Kenneth A DeJong (2010).Evolutionary Computation A Unified Approach***. Prentice Hall of India, New Delhi.
2. ***Kramer, Oliver (2017). Genetic Algorithm Essentialsm.*** Springer Verlag publication
3. ***Nirwan Ansari, Edwin Hon (2012).Computational Intelligence for Optimization*****.** Springer Verlag publication
4. ***Helio Barbosa (2013). Ant Colony optimization****: Techniques and Applications. InTechOpen*
5. ***Maurice Clerc (2013). Particle Swarm Ooptimiztion***. Morgan Kaufmann Publishers, USA.


**Course Outcomes:**
At the end of the course, students will be able to

**CO1:** Understand the introduction of evolutionary computation.
**CO2:** Learn the concept of simulated annealing.
**CO3:** Understand about the basics of genetic algorithms.
**CO4:** Gain knowledge about the concept of ant colony optimization.
**CO5:** Gain knowledge about the concept of particle swarm optimization.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | H | M | M | - | - | - | - | - | L | - | M |
| CO2 | M | H | M | - | - | - | - | - | - | L | - | M |
| CO3 | L | H | - | M | - | - | - | - | - | M | - | L |
| CO4 | L | H | M | M | - | - | - | -- | - | L | - | M |
| CO5 | M | H | M | - |  | - | - | - | - | L |  | M |

## Compiler Design

**PE V**

**Semester III** **Hours of Instruction/ week: 4T**
**19MEOE53** **No. of Credits: 4**

**Objective:**
To understand the phases of the compilation process and be able to describe the purpose and implementation approach of each phase.

**Unit I Introduction** **12**
Language processors, The Structure of a Compiler, Applications of Compiler Technology, syntax Definition, Syntax Directed Translation, Parsing.

**Unit II Lexical Analysis** **12**

The Role of Lexical Analyser, Specifications of tokens, Recognition of tokens, The Lexical, Analyser Generator Lexical , Finite Automata, Regular Expressions to Automata, Optimization of DFA, Based Pattern Matchers.

**Unit III Syntax Analysis** **12**

Introduction, Context, Free Grammars, Writing a Grammar, Top, Down Parsing, Bottom, Up Parsing, Introduction to LR Parsing- Simple LR, More Powerful LR Parses, Using Ambiguous Grammar, Parser Generators.

**Unit IV Intermediate Code Generation and Runtime Environment** **12**

Variants of Syntax Trees, Three, Address Code, Types and Declarations, Translation of Expressions, Type checking, Control Flow, Back patching, Switch, Statements, Run Time Environments- Storage Organization, Stack Allocation of Space, and Access to Nonlocal Data on the Stack.

**Unit V Code Generation and Code Optimization** **12**

Code Generation: Issues in the Design of a Code Generator, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization, Machine Independent Optimizations- The Principle Sources of Optimization, Introduction to Data, Flow Analysis, Loops in Flow Graphs.

**Total Hours : 60**

**References:**


1. ***AlferdV.Aho. Monica S.Lam. Ravi Sethi, JeffereyD.Ullman (2011).Compilers Principles Techniques and Tools.*** Second Edition, Pearson Education.
2. ***H.S.Mohan (2014). Compiler Design.*** Alpha Science International Ltd.
3. ***V.Raghavan (2010). Principles of Compiler Design.*** Tata McGraw-Hill.
4. ***Reihard Wihelm, Helmut Seidl, Sebastian (2010). Compiler Design: Syntactic and Semantuic Analysis***. Springer.


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**Course Outcomes:**

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

**CO1:** Understand the various phases of compiler and syntax directed translation
**CO2**: Gain knowledge on lexical analysis and finite automata for a given grammar
**CO3**: Understand about the syntax analysis and different LR parsers
**CO4**: Know the concepts of intermediate code generation and runtime storageenvironment
**CO5:** Understand the generation of code and code optimization methods

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | M | - | - | - | L | - | M | - | - |
| CO2 | M | M | - | - | H | - | - | - | - | M | | - |
| CO3 | M | H | - | M | - | - | M | - | - | L | - | - |
| CO4 | H | - | M | - | H | M | - | - | - | M | - | L |
| CO5 | M | - | H | - | - | - | L | - | - | L | - | - |

**Open Elective**

**Web Mining**

**OE**

**Semester III** **Hours of Instruction/ week: 4T**
**19MEOO01** **No. of Credits: 4**

**Objective:**

To understand the concepts in Web mining, Social Network Analysis and opinion mining for analyzing the web data.

**Unit I Introduction 12**

What is the World Wide Web?- Web Data Mining- Information Retrieval and Web Search- Basic Concepts of Information Retrieval- Information Retrieval Models- Relevance Feedback- Evaluation Measures- Text and Web Page Pre-Processing- Inverted Index and Its Compression- Latent Semantic Indexing- Web Search- Meta-Search- Web Spamming.

**Unit II Social Network Analysis & Web Crawling 12**

Social Network Analysis- Co-Citation and Bibliographic Coupling- PageRank- HITS- A Basic Crawler Algorithm- Implementation Issues- Universal Crawlers- Focused Crawlers- Topical Crawlers.

**Unit III Structured Data Extraction: Wrapper Generation 12**

Preliminaries- Wrapper Induction- Instance-Based Wrapper Learning- Automatic Wrapper Generation: Problems- String Matching and Tree Matching- Multiple Alignment- Building DOM Trees- Extraction Based on a Single List Page: Flat Data Records- Nested Data Records- Extraction Based on Multiple Pages- Issues based on single and Multiple Pages.

**Unit IV Opinion Mining 12**

Opinion Mining: Problem –Document sentiment classification - Sentence Subjectivity and Opinion Lexicon Expansion- Aspect-Based Opinion Mining- Mining Comparative Opinions - Opinion arch and Retrieval- Opinion Spam Detection.

**Unit V Web Usage Mining 12**

Data Collection and Pre-Processing- Data Modelling for Web Usage Mining –Discovery and Analysis of web usage mining - Recommender Systems and Collaborative Filtering- Query Log Mining.

**Total Hours: 60**

**References:**


1. ***Bing Liu (2011). Web Data Mining.*** Second Edition. Springer.
2. ***GuandongXu and Yanchun Zhang(2012).Web Mining and Social Networking: Techniques and Applications.*** Springer.
3. ***V. S. Kumbhar (2016).Web Mining: A Synergic Approach Resorting to Classifications and Clustering.*** River Publishers.
4. ***Guandong Xu, Yanchun Zjang, Lin Li (2010). Web Mining and Social Networking: Techniques and Applications,*** Springer

**Course Outcomes:**

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

**CO1:** Learn to analyze web mining problems- worked upon at the research frontier.
**CO2:** Understand the key concepts of social network analysis and crawler algorithms.
**CO3:** Evaluate the appropriate tools and techniques for extracting data from web pages.
**CO4:** Apply Opinion Mining techniques for solving problems in web spamming.
**CO5:**Analyze the concepts of web usage mining.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | L | M | H | - | - | M | - | - | M | - | - |
| CO2 | M | H | - | - | - | - | H | - | - | L | - | L |
| CO3 | M | - | M | - | H | L | - | - | - | M | - | - |
| CO4 | M | - | M | - | H | M | - | - | - | M | - | - |
| CO5 | M | M | - | - | H | - | - | - | - | M | - | - |

**Audit Course-I**
**English for Research Paper Writing**
**(Non-credit Mandatory Course)**

**Semester I** **Hours of Instruction/week: 3**
**19MEMA11**

**Objective:**
To make the students to write an effective research paper

**Unit I Planning and Preparation**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness **9**

**Unit II Findings and Review**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction, charts, tables for data and results. **9**

**Unit III Review of Literature**
Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check **9**

**Unit IV Key Skills**
Key skills needed when writing a title, key skills needed when writing an abstract, key skill needed when writing an introduction, skills needed when writing a review of the literature **9**

**Unit V Quality**
Useful phrases, how to ensure paper is as good as it could possibly be at the time of first- time submission and substantiated with valid research evidences. **9**

**Total hours: 45**

**References:**


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


**Course Outcomes:**
Upon completion of the course, the student will be able to

CO1 : Understand how to improve writing skills and level of readability
CO2 : Learn about the writing method in each section
CO3 : Understand and develop the research papers
CO4 : Identify the key skills and useful phrases for writing good quality of paper
CO5 : Substantiate with evidences for results and outcome.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | M | - | - | - | - | - | - | - | - | M |
| CO2 | H | H | M | - | - | - | - | - | - | - | - | M |
| CO3 | M | H | M | - | - | - | - | - | - | - | - | M |
| CO4 | M | H | M | M | - | - | - | - | - | - | - | M |
| CO5 | H | H | M | - | - | - | - | - | - | - | - | M |

**Disaster Management**
**(Non-credit Mandatory Course)**

**Semester I** **Hours of Instruction/week: 3**

**19MEMA12**

**Objective:**

To provide board understanding about the basic concepts of disaster management

**Unit I Introduction**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **9**

**Unit II 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. **9**

**Unit III 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 **9**

**Unit IV 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 **9**

**Unit V Risk Assessment and Disaster Mitigation**

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. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India. **9**

**Total Hours: 45**

**References:**


1. ***R. Nishith, Singh AK(2004). Disaster Management in India: Perspectives, issues and strategies.*** New Royal book Company
2. ***Pardeep Sahni, Alka Dhameja, Uma Medury (2009). Disaster Mitigation Experiences and Reflections.*** Prentice Hall of India.
3. ***Goel S. L. (2008). Disaster Administration and Management Text and Case Studies.*** Deep & Deep Publication Pvt. Ltd.,.

**Course Outcomes:**

Upon completion of the course, students will be able to

CO1 : Familiarize between natural and man-made disaster

CO2 : Learn about the repercussions of disasters and hazards

CO3 : Observe the various disaster prone areas in India

CO4 : Describe the different monitoring phenomena, evaluation of risk and management

CO5 : Understand the concepts of risk assessment and disaster mitigation

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | - | - | - | M | M | - | - | - | - | M |
| CO2 | H | H | - | - | - | M | M | - | - | - | - | M |
| CO3 | M | H | - | - | - | M | M | - | - | - | - | M |
| CO4 | M | H | - | M | -- | M | M | - | - | - | - | M |
| CO5 | M | H | - | - | | M | M | - | | - | - | M |

**Audit Course-II**
**Pedagogy Studies**
**(Non-credit Mandatory Course)**

**Semester II** **Hours of Instruction/week: 3T**
**19MEMA21**

**Objective:**
To provide the knowledge about pedagogy studies

**Unit I Introduction and Methodology**
Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**,** Overview of methodology and Searching. **9**

**Unit II Thematic overview**
Pedagogical practices that are used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. **9**

**Unit III Evidence on the effectiveness of pedagogical practices**
Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. **9**

**Unit IV Professional development**
Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes. **9**

**Unit V Research gaps and future directions**
Research design, context, Pedagogy, Teacher education, curriculum and assessment
Dissemination and research impact. **9**

**Total Hours: 45**

**References:**


1. ***Ackers J. Hardman F (2001). Classroom interaction in Kenyan primary schools.*** Compare.
2. ***Agrawal M (2004). Curricular reform in schools: The importance of evaluation.*** Journal of Curriculum Studies
3. ***Akyeampong K (2003). Teacher training in Ghana - does it count?"*** Multi-site teacher education research project (MUSTER) country report 1. London
4. ***Akyeampong K, Lussier K, Pryor J, Westbrook J (2013). Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?*** International Journal Educational Development
5. ***Alexander RJ(2001). Culture and pedagogy: International comparisons in primary education"***. Oxford and Boston: Blackwell
6. ***Chavan M (2003). Read India: Amassscale. Rapid, 'learning to read' campaign.***

**Course Outcomes:**

Upon completion of the course, students will be able to

CO1 : Understand conceptual framework and terminology

CO2 : Develop Pedagogical practices used by teachers for the study

CO3 : Understand the effectiveness of pedagogical practices and methodology in depth

CO4 : Create professional development with classroom practices and know the barriers to learning

CO5 : Understand the research gaps and future directions of research impact

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | - | - | - | M | M | - | - | - | - | M |
| CO2 | H | H | - | - | - | M | M | - | - | - | - | M |
| CO3 | M | H | - | - | - | M | M | - | - | - | - | M |
| CO4 | M | H | - | - | - | M | M | - | - | - | - | M |
| CO5 | M | H | L | - | - | M | M | - | - | - | - | M |

**Audit Course-II**
**Stress Management by Yoga**
**(Non-credit Mandatory Course)**

**Semester II** **Hours of Instruction/ week: 3T**
**19MEMA23**

**Objective:**

To learn the fundamental concepts and benefits in Yoga.

**Unit I Introduction to Yoga**

Origin of Yoga and its brief development – Meaning of Yoga and its importance – Yoga as a science of Art -Definitions of Eight parts of yoga (Ashtanga) **9**

**Unit II Classifications of Yoga**

Classification of Yoga/ Types of Yoga – 'hatha Yoga – Raja Yoga – Laya Yoga – Bhakti Yoga – GyanYoga,Karma Yoga and Asthang Yoga. **9**

**Unit III Principles of Yoga**

Principles of Yogic Practices, Meaning of Asana - its types and principles, Meaning of Pranayama-its types and principles, Meaning of kriya-its types and principles. **9**

**Unit IV Therapies of Yoga**

Yogic therapies and modern concept of yoga, Naturopathy, Hydrotherapy, electrotherapy, Messotherapy, Acupressure, Acupuncture, Meaning and importance of prayer, Psycolology of mantras, Different mudras during prayers. **9**

**Unit V Benefits of Yoga**

Various yoga poses and their benefits for mind & body Regularization of breathing techniques and its effects –Types of Pranayam. **9**

**Total Hours: 45**

***References:***


1. ***Yogic Asanas for Group Tarining-Part-I****:* Janardan Swami YogabhyasiMandal, Nagpur
2. ***Rajayoga or conquering the Internal Nature***by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.


**Course Outcomes:**

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

**CO1:** Develop healthy mind in a healthy body thus improving social health.

**CO2:** Demonstrate in guiding asana practice with minimum intervention and ability to modify asanas properly and understand the contraindication

**CO3:** Apply the principles of yoga in a personal way outside of yoga practice

**CO4**: Develop critical Thinking skills and science –based literacy to advance evolution of yoga therapy as an integrative health practice

**CO5:** Explore relaxation techniques to observe thoughts and to manage emotions.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | M | M | - | - | - | - | - | - | - | M |
| CO2 | H | M | - | - | - | - | - | - | - | - | - | M |
| CO3 | M | M | M | - | - | - | - | - | - | - | - | M |
| CO4 | - | M | L | - | - | - | - | - | - | - | - | H |
| CO5 | M | M | M | - | - | - | - | - | - | - | - | H |