SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

SYLLABUS

M.TECH.
(SOFTWARE ENGINEERING)

SEMESTER I

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE11
Course Name Mathematical Foundation of Computer Science
Pre-Requisites Discrete Mathematics

COURSE 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.
- 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.
- To study various sampling and classification problems.

Total Hours: 60

Unit 1 (10 Hours)
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 2 (10 Hours)
Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**,**

Unit 3(10 Hours)
Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.

Unit 4 (09 Hours)
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 5(11 Hours)
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.

Unit 6 (10 Hours)
Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatic, soft computing, and computer vision.

COURSE OUTCOMES
After completion of course, students would be able to:

- To understand the basic notions of discrete and continuous probability.
- To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
- 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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE12
Course Name Advanced Data Structures
Pre-Requisites UG level course in Data Structures

COURSE OBJECTIVE

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

Total Hours: 60
Unit 1 (11 Hours)
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 2(09Hours)
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3 (08 Hours)
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4 (12 Hours)
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 5 (10 Hours)
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.

Unit 6 (10 Hours)
Recent Trands in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem

COURSE OUTCOMES
After completion of course, students would be able to:

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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE13(A)
Course Name Operating System Design
Pre-Requisites Data Structure, Algorithms, Computer Architecture and Organization

COURSE OBJECTIVE

- The objective of the course is to provide introduction to operating system design and concept of process, process lifecycle and scheduling approaches.

Total Hours: 60

Unit 1: (10 Hours)
Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems.

Unit 2: (08 Hours)
Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and micro-kernels.

Unit 3: (12 Hours)
Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies.

Unit 4: (10 Hours)
Memory management, Virtual memory concept, Virtual machines, I/O management, File and disk management, Operating system security.

Unit 5: (10 Hours)
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.

Unit 6: (10 Hours)
Recent trends in Operating system design and their applicability to HPC.

COURSE OUTCOMES
After completion of course, students would be:

- Understanding advanced concepts in operating systems.
- Learning principles of Distributed and multiprocessor operating systems

References:
1. Advanced concept in operating system: M. Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE13(B)
Course Name Software Engineering

COURSE OBJECTIVE

- The objective of this course is to introduce the process of Software Engineering.

Total Hours: 60

Unit : 1 **(12 Hours)**
System Engineering : Hierarchy of system engineering, Product engineering, Requirements Engineering, System Modeling, Requirement Analysis, Analysis Principles, Software Prototyping, Software Requirement Specification, Software Engineering Process.

Unit : 2 **(12 Hours)**
Analysis Modeling : Elements of Analysis modeling, Data Modeling, Function Modeling and information flow, Behavioral modeling, Mechanics of structured analysis, data dictionary and other classical analysis methods, USE CASE modeling, UML Scenario, activities and class diagram.

Unit3: **(12Hours)**
Design Concepts and Principles: Design Process, Design Concepts, Effective Modular Design Functional Independence, coupling and cohesion, Software Architectural Design -Data Design , Architectural Styles, Mapping Requirements into a Software Architecture, Transform Mapping, Transaction Mapping, User Interface Design, Task Analysis and Modeling, Implementation tools, Design Evaluation, Component Level design.

Unit4: **(12 Hours)**
Software Testing Techniques & Stragies :White Box Testing, Basis Path Testing, Control Structure Testing Black Box Testing, Graph Based Testing Methods, Equivalence Partitioning, Boundary Value Analysis, Comparison Testing, Orthogonal Array Testing, Strategic Issues, Unit testing, Integration testing, Validation testing, System Testing, Formal Technical Review.

Unit5: **(12 Hours)**
Software Technical Metrics : Software Quality – McCall's Quality Factors, FURPS , Framework for technical software Metrics, Metrics for the analysis model, function based Metrics, Bang Metric, Metrics for design Model Architectural Design Metrics, Component Level Design Metrics, Interface Design Metrics, Metrics for source code, Metrics for Testing and Maintenance.

COURSE OUTCOMES
After completion of course, students would be:

- Familiar with the Process of Software Engineering.
- Understanding Software Design and Software Testing.

References:

1. R.S.Pressman, "Software Engineering: A Practitioner's Approach", Sixth edition 2006, McGraw-Hil.
2. Sommerville, "Software Engineering", Pearson Education
3. Rechard H.Thayer, "Software Engineering & Project Managements", Willey India
4. Mustafa & Khan, "Software Testing-Concepts and Practices", Narosa Pub House.
5. Behforooz & Hudson, "Software Engineering Fundamentals", Oxford Univ. Press.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE13(C)
Course Name Introduction to Intelligent Systems
Pre-Requisites Data Structures and Data Management or Data Structures

COURSE OBJECTIVE

- 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 behavior including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Total Hours: 60

Unit 1: (10 Hours)
Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.

Unit 2: (08 Hours)
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit 3: (12 Hours)
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, hillclimbing search. Optimization and search such as stochastic annealing and genetic algorithm.

Unit 4: (10 Hours)
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 5: (10 Hours)
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.

Unit 6: (10 Hours)
Recent trends in Fuzzy logic, Knowledge Representation

COURSE OUTCOMES
After completion of course, students would be:

- Able to Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyze 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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE14(A)
Course Name Data Warehouse and Mining

Course Objectives:

1. To identify the scope and essentiality of Data Warehousing and Mining.
2. To analyze data, choose relevant models and algorithms for respective applications.
3. To study spatial and web data mining.
4. To develop research interest towards advances in data mining.

Total Hours: 60

Unit 1: (12 Hours)
Introduction : Data Mining: Definitions, KDD v/s D DM techniques, Mining problems, Issues and Challenges in DM, DM Application areas.

Unit 2: (12 Hours)
Association Rules & Clustering Techniques like A Priori, Partition, Pincer search etc., Gen paradigms; Partitioning algorithms like K clustering, DBSCAN, BIRCH, CURE; categorical clustering algorithms, STIRR, ROCK, CACTUS.

Unit 3: (12 Hours)
Other DM techniques & Web Mining Genetic algorithm, Decision tree in DM. Web Mining, Web content mining, Web structure Mining, Web Usage Mining.

Unit 4: (12 Hours)
Temporal and spatial DM: Temporal association rules, Sequence Mining, GSP, SPADE, SPIRIT, and WUM algorithms, Episode Discovery, Event prediction, Time series analysis.

Unit 5: (12 Hours)
Spatial Mining, Spatial Mining tasks, Spatial clustering, Spatial Trends. Data Mining of Image and Video : A case study. Image and Video representation techniques, feature extraction, motion analysis, content based image and video retrieval, clustering and association paradigm, knowledge discovery. The vicious cycle of Data mining, data mining methodology, measuring the effectiveness of data mining data mining techniques. Market baskets analysis, memory based reasoning , automatic cluster detection, link analysis, arti automatic cluster detection, link analysis, artificial neural networks, generic algorithms, data mining and corporate data warehouse, OLAP.

Course Outcomes:

Students will be able to:

1. Understand Data Warehouse fundamentals, Data Mining Principles
2. Design data warehouse with dimensional modelling and apply OLAP operations.
3. Identify appropriate data mining algorithms to solve real world problems.

4. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
5. Describe complex data types with respect to spatial and web mining. 6. Benefit the user experiences towards research and innovation, integration.

Reference Books :

1. Data Mining Techniques ; Arun K.Pujari ; University Press.
2. Data Mining; Adriaans & Zantinge; Pearson education.
3.Mastering Data Mining; Berry Linoff; Wiley.
4.Data Mining; Dunham; Pearson education.
5.Text Mining Applications, Konchandy, Cengage

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE14(B)
Course Name Distributed Systems
Pre-Requisites Database Management Systems

COURSE OBJECTIVE

- 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.

Total Hours: 60

Unit 1: (10 Hours)
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 2: (10 Hours)
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 3: (12 Hours)
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 4: (08 Hours)
RELIABILITY
Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Unit 5: (10 Hours)
PARALLEL DATABASE SYSTEMS

Parallel architectures; parallel query processing and optimization; load balancing

Unit 6: (10 Hours)
ADVANCED TOPICS
Mobile Databases, Distributed Object Management, Multi-databases

COURSE OUTCOMES
After completion of course, students would be:

- Design trends in distributed systems.
- Apply network virtualization.
- 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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE14(C)
Course Name Advanced Wireless and Mobile Networks
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.

Total Hours: 60

Unit 1: (12 Hours)
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 2: (10 Hours)
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 3: (08 Hours)
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 4: (10 Hours)
WIRELESS PANs
Bluetooth AND Zigbee, Introduction to Wireless Sensors,

Unit 5: (10 Hours)
SECURITY
Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

Unit 6: (10 Hours)
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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE15
Course Name Research Methodology and IPR

Course objectives:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Total Hours: 60
Syllabus Contents:
Unit 1: (10 Hours)
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

Unit 2: (10 Hours)
Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: (10 Hours)
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: (10 Hours)
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 5: (10 Hours)
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases. Geographical Indications.

Unit 6: (10 Hours)
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:

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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.
- 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.

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, 2 ndEdition, "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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE16
Course Name English for Research Paper Writing

Course objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Total Hours: 60

Unit- I (10 Hours)
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit- II (10 Hours)
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit- III (10 Hours)
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit- IV (10 Hours)
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit- V(10 Hours)
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit- VI(10 Hours)
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Course Outcomes:
After successful completion of course student will be able to
1. Develope writing skills by analyzing model texts (written by ‘expert’ writers) and texts written by students (with particular focus on issues involving coherence and cohesion);
2. Expand academic vocabulary;
3. Consolidate more advanced aspects of English grammar relevant to writing research papers;
4. Consolidate of language functions found in research papers;
5. Comparing various practices and conventions used in writing research papers across a range of disciplines.

Suggested Studies:

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

SEMESTER II

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE21
Course Name Advanced Algorithms
Pre-Requisites UG level course in Algorithm Design and Analysis

COURSE OBJECTIVE

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

Total Hours: 60

Unit1 (10 Hours)
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 2(10 Hours)
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3(10 Hours)
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 4(12 Hours)
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 5(10 Hours)

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

Unit 6(08 Hours)
Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

COURSE OUTCOMES
After completion of course, students would be able to:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- 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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE22
Course Name Soft Computing
Pre-Requisites Basic knowledge of mathematics

COURSE OBJECTIVE

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

Total Hours: 60

Unit 1 (08 Hours)
INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2(10 Hours)
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 3(12 Hours)
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 4(10 Hours)
GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit 5(10 Hours)
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

Unit 6(10 Hours)
Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

COURSE OUTCOMES
After completion of course, students would be able to:

- Identify and describe soft computing techniques and their roles in building intelligent

machines

- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- 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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code CS23(A)
Course Name Data Preparation and Analysis
Pre-Requisites

COURSE OBJECTIVE

- To prepare the data for analysis and develop meaningful Data Visualizations

Total Hours: 60

Unit1: (15 Hours)
Data Gathering and Preparation:
Data formats, parsing and transformation, Scalability and real-time issues

Unit2: (15 Hours)
Data Cleaning:
Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit3: (15 Hours)
Exploratory Analysis:
Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Unit4: (15 Hours)
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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE23(B)
Course Name Advance Database Management System

COURSE OBJECTIVE

- To make students aware of advance concepts of Database Management System

Total Hours: 60

Unit 1(12 Hours)

DBMS Concepts Introduction, Data models, Entities and attributes, Relationships, E-R diagram. Relational Data models: Domains, Tupples, Attributes, Keys, Relational database, Schemas, Integrity constraints. Relational algebra and relational calculus, Normalization, Normal forms.

Unit 2(12 Hours)

Query Processing and Optimization. Distributed databases: Fragmentation, Replication, Location & Fragment transparency, Distributed Query Processing and Optimization.

Unit 3(12 Hours)

Object oriented and object relational databases: Specialization, Generalization, Aggregation and Association.

Unit 4(12 Hours)

Introduction to Image and Multimedia databases and data structures: Data structure- R tree, K d tree, Quad trees, Content based retrieval: Color Histograms.

Unit 5(12 Hours)

Web databases: Accessing databases through web.

COURSE OUTCOMES
After completion of course, students would be able to:

- Learn designing of Database Management Systems.
- Learn principles of Accessing Database through Web.

Reference Books:

1. R. Elmasri, S. Navathe, Fundamentals of Database System, Benjamin Cummings
2. C.J. Date, An Introduction to Data base Systems, Volume I, Addison Wesly
3. H. F. Korth and A. Silberschatz. Database Concept, TMH
4. Object Oriented databases :Narang, Prentice-Hall of India, New Delhi
5. Rob, Database Systems, Cengage, (Thomson)
6. Pratt, Concepts of DBMS, Cengage.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE23(C)
Course Name Data Visualisation
Pre-Requisites Computer Graphics, Image Processing

COURSE OBJECTIVE

- familiarize students with the basic and advanced techniques of information visualization and scientific visualization,
- to learn key techniques of the visualization process
- a detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques.

Total Hours: 60

Unit 1: (10 Hours)
Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

Unit 2: (10 Hours)
Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Unit 3: **(10 Hours)**
Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

Unit 4: (10 Hours)
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

Unit 5: (10 Hours)
Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

Unit 6: (10 Hours)
Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.

COURSE OUTCOMES
On completion of the course the student should be able to

- familiar with the design process to develop visualization methods and visualization systems, and methods for their evaluation.
- preparation and processing of data, visual mapping and the visualization
- have an understanding of large-scale abstract data,

References:
1. WARD, GRINSTEIN, KEIM,.Interactive Data Visualization: Foundations, Techniques, and Applications. Natick : A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE24(A)
Course Name Human and Computer Interaction

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.

Total Hours: 60

Unit 1: (10 Hours)

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 2: (12 Hours)

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 3: (08 Hours)

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

Unit 4: (10 Hours)

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 5: (10 Hours)

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

Unit 6: (10 Hours)

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)

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE24(B)
Course Name Web Analytics and Development

COURSE OBJECTIVE

- The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.

Total Hours: 60

Unit 1: (12 Hours)
Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization

Unit 2: (12 Hours)
Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys

Unit 3: (12 Hours)
Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models

Unit 4: (12 Hours)
Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity

Unit 5: (12 Hours)
Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation**.**

COURSE OUTCOMES
After completion of course, students would be:

- Become familiar with core research communities, publications, focused on web and social media analytics and research questions engaged in

References:
1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analyzing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann, 304.
2. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
3. Easley, D. & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press.
http://www.cs.cornell.edu/home/kleinber/networks-book/
4. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE24(C)
Course Name Knowledge Discovery
Prerequisites Data structures, Basic Statistics

COURSE OBJECTIVE

- Conduct case studies on real data mining examples

Total Hours: 60

Unit 1: (10 Hours)
Introduction KDD and Data Mining - Data Mining and Machine Learning, Machine Learning and Statistics, Generalization as Search, Data Mining and Ethics

Unit 2: (10 Hours)
Knowledge Representation - Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Trees for Numeric Predictions, Neural Networks, Clusters

Unit 3: (12Hours)
Decision Trees - Divide and Conquer, Calculating Information, Entropy, Pruning, Estimating Error Rates, The C4.5 Algorithm
Evaluation of Learned Results- Training and Testing, Predicting Performance, Cross-Validation

Unit 4: (08 Hours)
Classification Rules - Inferring Rudimentary Rules, Covering Algorithms for Rule Construction, Probability Measure for Rule Evaluation, Association Rules, Item Sets, Rule Efficiency

Unit 5: (10 Hours)
Numeric Predictions - Linear Models for Classification and Numeric Predictions, Numeric Predictions with Regression Trees, Evaluating Numeric Predictions

Unit 6: (10 Hours)
Artificial Neural Networks – Perceptrons, Multilayer Networks, The Backpropagation Algorithm
Clustering - Iterative Distance-based Clustering, Incremental Clustering, The EM Algorithm

COURSE OUTCOMES
After completion of course, students would be:

- Able to have knowledge of various knowledge representation methods.

References:
1. Data mining and knowledge discovery handbook by Maimon, oded(et al.)
2. Data Cleansing : A Prelude to knowledge Discovery.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE25
Course Name CONSTITUTION OF INDIA

Course Objectives:
Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Total Hours: 60

Unit 1: (10 Hours)

- **History of Making of the Indian Constitution:**

History
Drafting Committee, (Composition & Working)

Unit 2: (10 Hours)

- **Philosophy of the Indian Constitution:**

Preamble
Salient Features

Unit 3: (10 Hours)

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

Unit 4: (10 Hours)

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor

- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit 5: (10 Hours)

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative,
- CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit 6: (10 Hours)

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

Suggested reading

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

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

SEMESTER III

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE31(A)
Course Name Cloud Computing
Pre-Requisites

COURSE OBJECTIVE

- The student will also learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Total Hours: 60
Unit 1: (10 Hours)
Introduction to Cloud Computing
Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

Unit 2: (12 Hours)
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 Traditional Software Model, 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, Barriers to Cloud Computing Adoption in the Enterprise

Unit 3: (08 Hours)
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

Unit 4: (10 Hours)
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

Unit 5: (10 Hours)
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

Unit 6: (10 Hours)
ADVANCED TOPICS
Recent developments in hybrid cloud and cloud security **COURSE OUTCOMES**

After completion of course, students would be able to:

- Identify security aspects of each cloud model
- Develop a risk-management strategy for moving to the Cloud
- Implement a public cloud instance using a public cloud service provider
- Apply trust-based security model to different layer

References:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication
Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE31(B)
Course Name High Performance Scientific Computing
Model Curriculum of Engineering & Technology PG Courses [Volume-I]
Pre-Requisites Linear Algebra and Numerical Methods, Parallel Algorithms

COURSE OBJECTIVE

- The aim of the course is to provide insight to high performance computation techniques, and Parallel heterogeneous computation languages which includes MPI and OpenMP.

Total Hours: 60
Unit 1: (10 Hours)
Overview of parallel system organization

Unit 2: (10 Hours)
Introduction to message passing and MPI programming

Unit 3: (10 Hours)
Embarrassingly parallel problems; Problem decomposition, graph partitioning, and load balancing

Unit 4: (10 Hours)
Introduction to shared memory and OpenMP programming;

Unit 5: (10 Hours)
Examples of scientific computing, Parallel Languages.

Unit 6: (10 Hours)
Case study of Problem decomposition, graph partitioning, and load balancing using OpenMP.

COURSE OUTCOMES
After completion of course, students would be:

- Familiar with parallel and shared memory architecture and parallel computation languages which includes MPI and OpenMP.

References:
1. Parallel Programming for Multicore and Cluster Systems by Thomas Rauber and Gudula Runger.
2. Scientific Parallel Computing by Scott, Clark, and Bagheri.
3. Using OpenMP: Portable Shared Memory Parallel Programming by Chapman, Jost, and van der Pas.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE31(C)
Course Name Optimization Techniques
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 specially for NP-Hard problems.

Total Hours: 60

Unit 1: (10 Hours)
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

Unit 2: (10 Hours)
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit 3: (10 Hours)
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

Unit 4: (10 Hours)
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

Unit 5: (10 Hours)
Real life Problems and their mathematical formulation as standard programming problems.

Unit 6: (10 Hours)
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.

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE32(A)
Course Name Business Analytics
Prerequisites
Course objective

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.

Total Hours: 60

Unit1: (10 Hours)

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

Unit 2: (08 Hours)

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 3: (10 Hours)

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 4: (12 Hours)

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 Model Curriculum of Engineering & Technology PG Courses [Volume-I] [115] Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: (10 Hours)
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: (10 Hours)
Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES
1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE32(B)
Course Name Operations Research

Course objective

1. To impart knowledge in concepts and tools of Operations Research
2. To understand mathematical models used in Operations Research
3. To apply these techniques constructively to make effective business decisions

Total Hours: 60

Unit 1: **(08 Hours)**
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2(08 Hours)
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: **(09 Hours)**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4(08 Hours)
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5(09 Hours)
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Course Outcomes: At the end of the course, the student should be able to
1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

References:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
Model Curriculum of Engineering & Technology PG Courses [Volume-I] [117]
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

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

Course Code SE32(C)
Course Name Cost Management of Engineering Projects

Course objective

The objectives of this course are to:
1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.

Total Hours: 60

Unit 1(12 Hours)
Introduction and Overview of the Strategic Cost Management Process 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 2(12 Hours)
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 Cost Behavior and Profit

Unit 3(12 Hours)
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,

Unit 4(12 Hours)
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 5(12 Hours)
Quantitative techniques for cost management, Linear Programming PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Course Outcomes:

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

1.Understand project characteristics and various stages of a project.

2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.

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.