VISION AND MISSION

VISION OF THE DEPARTMENT

The Department of Computer Science and Engineering strives to create computing professionals, researchers, and entrepreneurs, with high technical knowledge, communication skills, values and ethics. It collaborates with academia, industry and community to set high standards in academic excellence and in fulfilling societal responsibilities.

MISSION OF THE DEPARTMENT

The mission of the Department of Computer Science and Engineering is to

- Provide motivated faculty and state of the art facilities for education and research, both in foundational aspects and of relevance to emerging computing trends.
- Develop knowledgeable, industry-ready students with pertinent competencies.
- Inculcate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- Engage in collaborative research with academia and industry for seamless transfer of knowledge resulting in patentable solutions.
- Generate adequate resources for research activities from sponsored projects and consultancy.
ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. COMPUTER SCIENCE AND ENGINEERING
(SPECIALIZATION IN OPERATIONS RESEARCH)
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES:
1. Prepare students to review and understand Concepts in Computer Science and Engineering and optimization techniques
2. Empower students to critically analyze current trends and learn future issues from a system perspective at multiple levels of detail and abstraction
3. Enable students to apply theory and practice for problem solving based on case studies
4. Enable students to pursue lifelong multidisciplinary learning as professional engineers and scientists to effectively communicate technical information, function effectively on teams, and apply computer science & engineering and optimization techniques within a global, societal, and environmental context by following ethical practices.
5. Prepare students to critically analyze existing literature, identify the gaps in the existing literature and propose innovative and research oriented solutions.

PROGRAM OUTCOMES:
Students will be able to:
1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex computer science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and computer science related tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
5. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
6. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme educational objective and the outcomes is given in the following table.

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## CHOICE BASED CREDIT SYSTEM

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*Audit course is optional

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**OPERATIONS RESEARCH ELECTIVES**

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**OPEN ELECTIVE COURSES (OEC)**

*(out of 6 courses one course must be selected)*

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AUDIT COURSES (AC)
Registration for any of these courses is optional to students

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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OBJECTIVES:

- To apply mathematical linear programming techniques to solve constrained problems.
- To appreciate the use of simulation techniques.
- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions.
- To impart knowledge of handling random vectors which represent random variables in multidimensional space.

UNIT I  LINEAR PROGRAMMING  12

UNIT II  SIMULATION  12
Discrete Event Simulation – Monte Carlo Simulation – Stochastic Simulation – Applications to real time problems.

UNIT III  ESTIMATION THEORY  12

UNIT IV  TESTING OF HYPOTHESIS  12

UNIT V  MULTIVARIATE ANALYSIS  12

OUTCOMES:

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

- Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.
- Simulate appropriate application/distribution problems.
- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:

CP5151 DATA STRUCTURES AND ALGORITHMS  

OBJECTIVES:

- To extend the students’ knowledge of algorithms and data structures.
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To understand various types of search and heap structures.
- To study various types of geometric, randomized and approximation algorithms.
- To extrapolate from them in order to apply those algorithms and techniques to solve problems.

UNIT I  FUNDAMENTALS  

UNIT II  SEARCH STRUCTURES  

UNIT III  HEAP STRUCTURES  
Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy – Binomial Heaps

UNIT IV  GEOMETRIC ALGORITHMS  
Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram

UNIT V  ADDITIONAL TOPICS  

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Analyze algorithms.
- Determine algorithm correctness.
- Choose appropriate data structures for the problems to be solved.
- Design algorithms for problems from different domains.
- Identify various research strategies on algorithmic design.
REFERENCES:

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CP5251 ADVANCED OPERATING SYSTEMS

OBJECTIVES:
- To understand the concepts of distributed systems.
- To get an insight into the various issues and solutions in distributed operating systems.
- To learn about real-time operating systems.
- To gain knowledge on the design concepts of mobile operating systems.
- To understand cloud operating systems.

UNIT I INTRODUCTION

UNIT II DISTRIBUTED OPERATING SYSTEMS
UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

UNIT IV REAL TIME OPERATING SYSTEMS 9

UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Identify the features of distributed operating systems.
- Demonstrate the various protocols of distributed operating systems.
- Identify the different features of real-time operating systems.
- Discuss the features of mobile operating systems.
- Discuss the features of cloud operating systems.

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OBJECTIVES:
- To formulate optimization problem and solve using graphical and simplex methods.
- To learn the principles of complex linear programming problems and its solutions.
- To analyse the sensitivity of different attributes for optimal solutions.
- To apply the solutions to integer programming problems.
- To design and apply solutions to various use cases using software tools.

UNIT I INTRODUCTION

UNIT II ADVANCED LINEAR PROGRAMMING

UNIT III SENSITIVITY ANALYSIS
Sensitivity Analysis or Post Optimality Analysis – Changes in the Right-handside – Objective function – Changes affecting feasibility – Changes affecting optimality.

UNIT IV INTEGER PROGRAMMING

UNIT V CASE STUDIES AND TOOLS
Case Studies – Production Planning– Manpower planning– Solving LP problems using TORA / LINDO / LINGO / LP Solver using R

OUTCOMES:
Upon completion of the course, the student will be able to
- Mathematically formulate and solve minimization/maximization problems.
- Solve transportation and assignment problems.
- Analyse sensitivity, post optimality, changes affecting feasibility and optimality.
- Model and solve integer programming problems like travelling salesman problems.
- Solve linear programming problems using software tools.

REFERENCES:
### PROGRAMME EDUCATIONAL OBJECTIVES

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**RM5151 RESEARCH METHODOLOGY AND IPR**

**OBJECTIVES:**
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

**UNIT I RESEARCH PROBLEM FORMULATION**
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 II LITERATURE REVIEW**
Effective literature studies approaches, analysis, plagiarism, and research ethics.

**UNIT III TECHNICALWRITING /PRESENTATION**
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 IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)**

**UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR)**

**TOTAL: 30 PERIODS**
OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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CP5161 DATA STRUCTURES AND ALGORITHMS LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To familiarize various data structure implementations.
- To implement heap and various tree structures like AVL, Red-black, B-Tree and segment trees.
- To understand efficient implementation of line segment intersection
- To understand various search structures.
- To get understanding of problem to program mapping.

List of Experiments:
1. Binary Search Trees
2. Min/Max Heap
3. Leftist Heap
4. AVL Trees
5. Red-Black Trees
6. B-Trees
7. Segment Trees
8. Line segment intersection

TOTAL: 60 PERIODS
OUTCOMES:
Upon completion of the course, the student will be able to
- Achieve programming skill to convert a problem to a programming logic.
- Apply suitable data structure for the problem in hand.
- Implement heap and various tree structures like AVL, Red-black, B-Tree and segment trees.
- Understand the usage of data structures for geometric problems
- Understand the importance of height balancing in search structures.

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OR5111 LINEAR PROGRAMMING LABORATORY

OBJECTIVES:
- To apply the knowledge of mathematics, engineering and linear programming to the design of solutions to complex engineering problems.
- To demonstrate knowledge and understanding of the linear programming principles in multidisciplinary environments.
- To create software programs, use modern tools and apply linear programming techniques.
- To conduct design of experiments for the specified needs with appropriate consideration.
- To demonstrate skill in interpretation of the data and synthesis of the information to provide valid inferences.

EXPERIMENTS:
1. Solving simplex maximization problems using R programming.
2. Solving simplex minimization problems using R programming.
3. Solving mixed constraints problems – Big M & Two phase method using TORA.
4. Solving transportation problems using R.
5. Solving assignment problems using R.
6. Solving optimization problems using LINGO.
7. Studying Primal-Dual relationships in LP using TORA.
8. Solving LP problems using dual simplex method using TORA.
9. Sensitivity & post optimality analysis using LINGO.

TOTAL: 60 PERIODS
OUTCOMES:

Upon Completion of the course, the students will be able to

- Apply linear programming techniques to solve complex engineering problems.
- Use solvers like LINGO, TORA to solve real life linear optimization problems.
- Design algorithms, create programs in R, apply appropriate techniques and analyse the convergence time of different methods.
- Provide instant results through programming tools (solvers).
- Draw inferences from the results and provide information aiding planning and decision making.

OR5251 ADVANCED DATABASES

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OBJECTIVES:

- To comprehend the underlying principles of Relational Database Management System.
- To develop database models using parallel and distributed databases.
- To understand the concepts of XML and Web databases.
- To apprehend the design and implementation of active temporal and deductive databases.
- To develop applications based on NOSQL database.

UNIT I RELATIONAL MODEL


UNIT II PARALLEL AND DISTRIBUTED DATABASES


UNIT III XML AND WEB DATABASES


UNIT IV ACTIVE TEMPORAL AND DEDUCTIVE DATABASES


UNIT V NO SQL DATABASES

NoSQL database vs traditional RDBMS database – Migrating from RDBMS to NOSQL – MongoDB – Database creation and Querying – Web Application development using MongoDB

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Design and implement relational databases.
- Design and implement parallel and distributed databases.
- Design and implement XML databases, Active, Temporal and Deductive databases.
- Implement the concept of database connectivity with the applications.
- Apply various data mining techniques.
REFERENCES:
2. Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and Techniques. 2011.

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CP5153 NETWORKING TECHNOLOGIES

OBJECTIVES:
- To learn about integrated and differentiated services architectures.
- To understand the working of wireless network protocols.
- To study the developments in cellular networks.
- To get familiarized with next generation networks.
- To know the concepts behind software defined networks.

UNIT I NETWORK ARCHITECTURE AND QoS

UNIT II WIRELESS NETWORKS
UNIT III  CELLULAR NETWORKS

UNIT IV  4G NETWORKS

UNIT V  SOFTWARE DEFINED NETWORKS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Identify the different features of integrated and differentiated services.
- Demonstrate various protocols of wireless networks.
- Analyze the use of next generation networks.
- Provide solutions using SDN.
- Design protocols for cellular networks.

REFERENCES:
OBJECTIVES:

- To learn the basic properties and solutions for nonlinear systems.
- To identify and apply solutions to unconstrained one dimensional nonlinear problems.
- To apply and solve unconstrained multi-dimensional nonlinear problems.
- To solve constrained nonlinear problems using various algorithms.
- To learn evolutionary programming approaches for optimisation.

UNIT I INTRODUCTION
Linear vs nonlinear programming – basic properties of solutions and algorithms – first order necessary conditions – examples of unconstrained problems – second order conditions – convex and concave functions – minimization and maximization of convex functions – saddle points – jacobian matrix

UNIT II ONE DIMENSIONAL OPTIMIZATION

UNIT III MULTI-DIMENSIONAL OPTIMIZATIONS

UNIT IV UNCONSTRAINED OPTIMIZATION FOR CONSTRAINED PROBLEMS
UNIT V  EVOLUTIONARY PROGRAMMING


TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Formulate mathematically the optimization problem and solve minimization/ maximization problems.
- Mathematically formulate and solve 1-dimensional/multi-dimensional nonlinear problems.
- Identify methods to solve constrained and unconstrained optimization problems.
- Understand meta-heuristic and evolutionary approaches to obtain global optima and their application scenarios.
- Apply the concepts of nonlinear programming in complex multi-disciplinary fields of engineering.

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OR5261  ADVANCED DATABASES LABORATORY  L T P C
        0 0 4 2

OBJECTIVES:
- To learn the DDL and DML operations.
- To understand the use of various Joins.
- To acquire knowledge on creation of views and nested queries.
- To write and use functions, triggers, and stored procedures.
- To use distributed databases, heterogeneous databases and XML databases.
LIST OF EXPERIMENTS:
3. Set Operations – Creating Views – Creating Sequence – Indexing – Aggregate Functions – Analytic Functions – Nested Queries
4. Creating Triggers and Stored Procedures
5. Implementation of Distributed Databases
6. Connecting Heterogeneous Databases
7. XML Databases
8. Accessing and Updating a Relational Database using PHP
9. Accessing and Updating a Relational Database using JDBC
10. Accessing and Updating MongoDB using PHP

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Create and carry out all Data Manipulation operations.
- Create queries using various Joins appropriately.
- Create and use views and nested queries.
- Write and use functions, triggers, and stored procedures.
- Use distributed databases, heterogeneous databases and XML databases.

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OR5211 NON-LINEAR PROGRAMMING LABORATORY

OBJECTIVES:
- To apply the knowledge of nonlinear programming techniques to design solutions to complex engineering problems.
- To explore the applications of nonlinear programming algorithms and solvers.
- To create software programs and use modern tools or solvers.
- To conduct design of experiments for the specified needs with appropriate consideration.
- To demonstrate skill in synthesis of the solutions to provide valid inferences.
Experiments to solve optimization problems by implementing and analysing the efficiency of the following using a programming language making use of optimization libraries or solvers:

1. Develop a program to solve first order ordinary differential equations
2. Develop a program to determine minima and maxima when given a of convex function
3. Implement Golden section search for solving one dimensional optimization problems
4. Implement Steepest descent method for solving one dimensional optimization problems
5. Implement Newton’s method for solving one dimensional optimization problems
6. Implement Conjugate directions method for solving multi-dimensional optimization problems
7. Implement Conjugate gradient method for solving multi-dimensional optimization problems
8. Implement Quasi-Newton method for solving multi-dimensional optimization problems
9. Implement Lagrange method for solving unconstrained optimization problems
10. Implement Parallel Steepest descent method for solving one dimensional optimization problems

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to

- Apply nonlinear programming techniques to solve complex engineering problems.
- Use solvers like NOPT, GSL to solve nonlinear optimization problems.
- Design algorithms, create programs and apply appropriate techniques.
- Analyse the convergence time of different algorithms and their complexity issues.
- Provide instant results through programming tools or solvers.

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CP5262 PROFESSIONAL PRACTICES L T P C
0 0 2 1

OBJECTIVES:
- To facilitate analysis, design and problem solving skills.
- To have a thorough domain knowledge.
- To understand the best Industry practices by reading case studies.
- To kindle innovative and professional thinking.
- To explore possible alternative solutions.
- To estimate feasibility, cost, risk and ROI.
SESSIONS BASED ON:
Identify an application/projects (may be of social relevance) – Understand customer requirements – Analyze and understand customers and stakeholders – value additions – innovations and research component – preparing plan / SRS document indicating feasibility, cost, risk, ROI and related design – suggest implementation methodology – perform risk assessment and management

TOTAL: 30 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to

- Identify and formulate the problem.
- Describe the background of the problem.
- Assess the needs of stakeholders.
- Make estimates like cost, risk, ROI etc., to justify the business opportunity.
- Describe the industry standards and procedures.
- Predict the business opportunity.
- Suggest system implications.

CP5086 SOCIAL NETWORK ANALYSIS L T P C
3 0 2 4

OBJECTIVES:
- To gain knowledge about the current web development and emergence of social web.
- To study about the modelling, aggregating and knowledge representation of semantic web.
- To appreciate the use of machine learning approaches for web content mining.
- To learn about the extraction and mining tools for social networks.
- To gain knowledge on web personalization and web visualization of social networks.

UNIT I CLUSTERING AND CLASSIFICATION 9+6

UNIT II SOCIAL MEDIA MINING 9+6

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 9+6


Upon completion of the course, the student will be able to
- Apply knowledge of current web development in the era of social web.
- Model, aggregate and represent knowledge for semantic web.
- Use machine learning approaches for web content mining.
- Design extraction and mining tools for social networks.
- Develop personalized web sites and visualization for social networks.

REFERENCES:
OBJECTIVES:
- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the theoretical and practical aspects of Probabilistic Graphical Models.
- To appreciate the concepts and algorithms of advanced learning.

UNIT I  INTRODUCTION  8+6
Machine Learning– Machine Learning process- Preliminaries for Machine Learning algorithms
Turning data into Probabilities and Statistics for Machine Learning- Probability theory – Probability
Distributions – Decision Theory.

UNIT II  SUPERVISED LEARNING  10+6
Linear Models for Regression – Linear Models for Classification- Discriminant Functions,
Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning –
Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks , Multi-

UNIT III  UNSUPERVISED LEARNING  9+6
Discriminant Analysis - Principal Components Analysis – Locally Linear Embedding – Isomap

UNIT IV  PROBABILISTIC GRAPHICAL MODELS  9+6
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical
Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields-
Hidden Markov Models – Conditional Random Fields(CRFs).

UNIT V  ADVANCED LEARNING  9+6
Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory
– Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and
Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

TOTAL : 45+30 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Design a learning model appropriate to the application.
- Design a Neural Network for an application of your choice.
- Implement Probabilistic Discriminative and Generative algorithms for an application of your
choice and analyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Design and implement an HMM for a Sequence Model type of application.
- Identify applications suitable for different types of Machine Learning with suitable
justification.

REFERENCES:
OBJECTIVES:
- To understand the concept of cloud and utility computing.
- To understand the various issues in cloud computing.
- To familiarize themselves with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.
- To be able to set up a private cloud.

UNIT I INTRODUCTION

UNIT II VIRTUALIZATION
Data Center Technology – Virtualization – Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing – Pros and Cons of Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V, KVM, Virtual Box

UNIT III CLOUD COMPUTING MECHANISM
UNIT IV  
HADOOP AND MAP REDUCE  
Apache Hadoop – Hadoop Map Reduce – Hadoop Distributed File System – Hadoop I/O-
Developing a Map Reduce Application – Map Reduce Types and Formats – Map Reduce Features – Hadoop Cluster Setup – Administering Hadoop.

UNIT V  
SECURITY IN THE CLOUD  

OUTCOMES:  
Upon completion of the course, the student will be able to
- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Identify the architecture, infrastructure and delivery models of cloud computing.
- Explain the core issues of cloud computing such as security, privacy and interoperability.
- Choose the appropriate technologies, algorithms and approaches for the related issues.
- Facilitate Service Level Agreements (SLA).

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TOTAL: 45 +30 = 75 PERIODS
OBJECTIVES:
- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing.

UNIT I  INTRODUCTION TO HACKING  9+6

UNIT II  SCANNING AND ENUMERATION  9+6

UNIT III  SYSTEM HACKING  9+6

UNIT IV  PROGRAMMING FOR SECURITY PROFESSIONALS  9+6

UNIT V  PENETRATION TESTING  9+6

OUTCOMES:
Upon completion of the course, the student will be able to
- Identify threats to computers.
- Defend hacking attacks.
- Protect data assets.
- Defend a computer against a variety of security attacks using various tools.
- Practice and use safe techniques on the World Wide Web.

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CP5079 DIGITAL IMAGE AND VIDEO PROCESSING  
L T P C 3 0 2 4

OBJECTIVES:
- To understand broad range of image processing techniques and their applications.
- To learn about video processing techniques and understand the video content.
- To appreciate various techniques used for acquisition, preprocessing, enhancement and analysis of Image and Video data.
- To appreciate the use of image& video processing in current technologies.
- To expose the students to real-world applications and case studies of the image& video processing.

UNIT I  FUNDAMENTALS OF IMAGE PROCESSING  9+6

UNIT II IMAGE ENHANCEMENT AND RESTORATION  9+6

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY  9+6

UNIT IV BASICS OF VIDEO PROCESSING  9+6
UNIT V VIDEO SEGMENTATION, TRACKING & APPLICATIONS 9+6


TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to
- Have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
- Critically 32odelli the role of video in modern technologies.
- Implement basic image and video processing algorithms.
- Design and develop various applications that incorporates different techniques of Image and Video processing.
- Apply and explore new techniques in the areas of Image and video Processing.

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CP5083 INTERNET OF THINGS L T P C
OBJECTIVES:
- To understand the different architectures for IoT.
- To learn various protocols at the different layers for IoT.
- To develop prototype systems using Arduino / Rasberry Pi.
- To apply the use of data analytics in IoT.
- To develop applications of IoT in Industrial contexts.
UNIT I  ARCHITECTURES AND MODELS  9+6

UNIT II  CONNECTIVITY  9+6

UNIT III  SYSTEM DEVELOPMENT  9+6
Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV  DATA ANALYTICS AND IoT SECURITY  9+6

UNIT V  IoT IN INDUSTRY  9+6

TOTAL : 45+30 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Explain the underlying architectures and models in IoT.
- Analyse different connectivity technologies for IoT.
- Develop simple applications using Arduino / Raspberry Pi.
- Apply data analytics techniques to IoT.
- Study the needs and suggest appropriate solutions for Industrial applications.

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CP5072 ADVANCED SOFTWARE ENGINEERING L T P C 3 0 2 4

OBJECTIVES:

- Comprehend the different stages of Software Development Lifecycle.
- Comprehend the Process of developing Analysis models and map the Analysis models to Design Models.
- Comprehend the Design Issues related to Web applications and Mobile Apps.
- Comprehend the Quality Factors associated with Software Development.
- Comprehend the use of different Testing Strategies in Software Development.

UNIT I PROCESS MODELS 9+6

UNIT II REQUIREMENTS MODELING AND DESIGN CONCEPTS 9+6
Understanding Requirements – Scenario based methods – Class based methods – Behavior, Patterns and Web/Mobile Apps – Design process – Design concepts – Design model

UNIT III SOFTWARE DESIGN 9+6
Architectural design – Component level Design–User Interface Design – Pattern based design –Web App design – Mobile App design

UNIT IV SOFTWARE QUALITY 9+6
UNIT V  SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT


TOTAL : 45+30 =75 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Select Appropriate Process Model for Software Development.
- Develop Analysis Models and Map the Analysis Models to Design Models.
- Address the Design Issues related To Web Applications and Mobile Apps.
- Incorporate Appropriate Quality Factors and Standards during Software Development.

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OBJECTIVES:
- To understand different forms of intermediate languages and modeling programs.
- To understand optimizations techniques for single program blocks.
- To apply optimizations on procedures and low level code.
- To explore and enhance inter procedural optimizations.
- To enhance resource utilization.

UNIT I INTERMEDIATE REPRESENTATION OF PROGRAMS AND ANALYSIS  9+6

UNIT II LOCAL AND LOOP OPTIMIZATIONS  9+6

UNIT III PROCEDURE OPTIMIZATION AND SCHEDULING  9+6

UNIT IV INTER PROCEDURAL OPTIMIZATION  9+6

UNIT V OPTIMIZING FOR MEMORY  9+6

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Identify the different optimization techniques that are possible for a sequence of code.
- Design performance enhancing optimization techniques.
- Manage procedures with optimal overheads.
- Understand modern programming language features and constructs.
- Learn to work on a larger software project.
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CP5084 PARALLEL ALGORITHMS

OBJECTIVES:
- To learn parallel algorithms development techniques for shared memory and DCM models.
- To study the main classes of fundamental parallel algorithms.
- Learn to design efficient parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.
- To understand parallel solutions for bitwise computation.

UNIT I INTRODUCTION
UNIT II   SORTING & SEARCHING  9
Sorting Networks – Sorting on a Linear Array – Sorting on CRCW, CREW, EREW – Searching a sorted sequence – Searching a random sequence – Bitonic Sort

UNIT III   ALGEBRAIC PROBLEMS  9
Permutations and Combinations – Matrix Transpositions – Matrix by Matrix multiplications – Matrix by vector multiplication.

UNIT IV   GRAPH & GEOMETRY  9
Connectivity Matrix – Connected Components – All Pair Shortest Paths – Minimum Spanning Trees – Point Inclusion – Intersection, Proximity and Construction Problems

UNIT V   OPTIMIZATION & BIT COMPUTATIONS  9
Prefix Sums – Job Sequencing – Knapsack – Adding two integers – Adding n integers – Multiplying two integers – Selection

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Understand the difference between sequential and parallel algorithms.
- Design parallel algorithms in various models of parallel computation.
- Apply a suitable model for developing a parallel algorithm.
- Know the basic issues associated with implementing parallel algorithms.
- Understand the differences among several algorithms used for solving the same problem and recognize which one is better under different conditions.

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OBJECTIVES:

- To understand the nature of threats and cyber security management goals and technology
- To understand the landscape of hacking and perimeter defense mechanisms
- To develop strategies for cyber security and protecting critical infrastructure
- To understand policies to mitigate cyber risks
- To understand the IT Act, scheme, amendments and emerging cyber law and desired cyber ecosystem capabilities

UNIT I  OVERVIEW OF CYBER SECURITY  9

UNIT II  ATTACKS AND COUNTERMEASURES  9

UNIT III  STRATEGIES FOR CYBER SECURITY  9

UNIT IV  POLICIES TO MITIGATE CYBER RISK  8

UNIT V  CRITICAL INFORMATION INFRASTRUCTURE PROTECTION  10

TOTAL: 45 PERIODS
OUTCOMES:
- Gain knowledge on the nature of threats and cyber security management goals and framework
- Knowledge on the landscape of hacking and perimeter defense mechanisms
- Ability to differentiate and integrate strategies for cyber security and protecting critical infrastructure
- Able to understand policies to mitigate cyber risks
- Knowledge on IT Act, and amendments, copy rights, IPR and cyber law to deal with offenses.

REFERENCES:
9. CGI, —Cyber security in Modern Critical Infrastructure Environments, 2014.

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OBJECTIVES:
- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in modeling applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading.

UNIT I INTRODUCTION

UNIT II GAMES WITH PERFECT INFORMATION

UNIT III GAMES WITH IMPERFECT INFORMATION

UNIT IV NON-COOPERATIVE GAME THEORY

UNIT V MECHANISM DESIGN

TOTAL: 45 PERIODS
OUTCOMES:
Upon Completion of the course, the students will be able to
- Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
- Discuss the use of Nash Equilibrium for other problems.
- Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
- Identify some applications that need aspects of Bayesian Games.
- Implement a typical Virtual Business scenario using Game theory.

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CP5071 ADHOC AND WIRELESS SENSOR NETWORKS L T P C 3 0 0 3

OBJECTIVES:
- To learn about the issues in the design of wireless ad hoc networks.
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks.
- To expose the students to different aspects in sensor networks.
- To understand various traffic generators and models for sensor networks.
- To understand various security issues in ad hoc and sensor networks and solutions to the issues.
UNIT I  FUNDAMENTALS AND ROUTING PROTOCOLS OF WIRELESS ADHOC NETWORKS


UNIT II  MOBILITY MODELS AND OVERHEAD CONTROL MECHANISMS IN MANETS

Description of Various Mobility Models – Simulation and Analysis of Various Mobility Models – Overhead Analysis in Hierarchical Routing Scheme – Overhead Minimization Techniques – Energy Models

UNIT III  WIRELESS SENSOR NETWORKS (WSN)


UNIT IV  PERFORMANCE ANALYSIS AND EVALUATION


UNIT V  SECURITY IN ADHOC AND SENSOR NETWORKS


TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to

- Identifying suitable routing protocols for various scenarios of ad hoc networks.
- To explore various mobility models for MANETs.
- Identify different issues in wireless sensor networks.
- Analyse the performance of IEEE 802.15.4.
- Identify and critique security issues in ad hoc and sensor networks.

REFERENCES:
**OBJECTIVES:**

- To understand the tasks in database administration.
- To learn the methods to secure the database and to recover from failures.
- To understand the fundamentals of database tuning.
- To apply indexing techniques and query optimization for database tuning.
- To understand and measure performance monitors to troubleshoot the database system.

**UNIT I**

**INTRODUCTION TO DATABASE ADMINISTRATION**


**UNIT II**

**DATABASE SECURITY, BACKUP AND RECOVERY**

UNIT III  FUNDAMENTALS OF TUNING  8

UNIT IV  INDEX TUNING AND QUERY OPTIMIZATION  9

UNIT V  TROUBLESHOOTING  8

OUTCOMES:
Upon completion of the course, the student will be able to
- Describe the principle functions in database administration and security.
- Discuss the need for performance tuning in databases.
- Write optimized code for accessing multiple databases.
- Reconstruct indexes and optimize queries for better database performance.
- Carry out troubleshooting in database systems.

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TOTAL: 45 PERIODS
OBJECTIVES:
- To understand data mining principles and techniques and Introduce DM as a cutting edge business intelligence.
- To expose the students to the concepts of data warehousing architecture and implementation.
- To learn various Data Mining techniques such as classification, clustering & Association rule mining
- To establish and house a centralized compilation of linked data.
- To study the overview of developing areas – web mining, text mining and ethical aspects of data mining.
- To identify business applications and trends of data mining.

UNIT I  INTRODUCTION TO DATA WAREHOUSING  9
Evolution of Decision Support Systems – Data warehousing Components – Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations

UNIT II  DATA WAREHOUSE PROCESS AND ARCHITECTURE  9
Types of OLAP servers, 3–Tier data warehouse architecture, distributed and virtual data warehouses. Data warehouse implementation, tuning and testing of data warehouse. Data Staging (ETL) Design and Development, data warehouse visualization, Data Warehouse Deployment, Maintenance, Growth, Business Intelligence Overview – Data Warehousing and Business Intelligence Trends – Business Applications – tools-SAS

UNIT III  INTRODUCTION TO DATA MINING  9
Data mining-KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques – Data mining knowledge representation – Data mining query languages, Integration of a Data Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies – Mining frequent patterns – association-correlation

UNIT IV  CLASSIFICATION AND CLUSTERING  9
Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Clustering techniques – Partitioning methods – k-means- Hierarchical Methods – distance based agglomerative and divisive clustering, Density – Based Methods – expectation maximization – Grid Based Methods – Model-Based Clustering Methods – Constraint – Based Cluster Analysis – Outlier Analysis

UNIT V  PREDICTIVE MODELING OF BIG DATA AND TRENDS IN DATA MINING  9

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of the course, the student will be able to

- Evolve multidimensional intelligent model from typical system.
- Discover the knowledge imbibed in the high dimensional system and gain knowledge on data warehouse process.
- Acquire knowledge of data processing and data quality.
- Design and deploy classification and clustering techniques.
- Evaluate various mining techniques on complex data objects.

REFERENCES:

1. Jiawei Han, Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann, Third edition, 2011.
OBJECTIVES:
- To understand the computational approaches to Modeling, Feature Extraction.
- To understand the need and application of Map Reduce.
- To understand the various search algorithms applicable to Big Data.
- To analyze and interpret streaming data.
- To learn how to handle large data sets in main memory.
- To learn the various clustering techniques applicable to Big Data.

UNIT I  DATA MINING AND LARGE SCALE FILES  9

UNIT II  SIMILAR ITEMS  9

UNIT III  MINING DATA STREAMS  9
Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS  9

UNIT V  CLUSTERING  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Design algorithms by employing Map Reduce technique for solving Big Data problems.
- Identify similarities using appropriate measures.
- Point out problems associated with streaming data and handle them.
- Discuss algorithms for link analysis and frequent itemset mining.
- Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

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OR5001  PYTHON PROGRAMMING FOR OPTIMIZATION TECHNIQUES  L T P C  3 0 2 4

OBJECTIVES:
- To develop solutions using python programming language.
- To familiarise with the organization and functions of python program.
- To design solutions using classes and objects in python.
- To acclimatize modern python optimization tools.
- To model optimization problems and develop efficient programs.

UNIT I  INTRODUCTION TO PYTHON  9+6

UNIT II  PROGRAM ORGANIZATION AND FUNCTIONS  9+6
Organize Large programs into functions – Python functions including scoping rules and Documentation strings – Modules and Libraries – Organize programs into modules – Installing third-party libraries. System administration, Text processing, Subprocesses, Binary data handling, XML parsing and Database Access.

UNIT III  CLASSES AND OBJECTS  9+6
Introduction to Object-oriented programming – Basic principles of Object-oriented programming in Python – Class definition, Inheritance, Composition, Operator overloading and Object creation – Solving problems in calculus, linear algebra and differentiation using libraries like scipy, numpy, sympy – Plotting using matplotlib

UNIT IV  SOLVING OPTIMIZATION PROBLEMS USING SCIPY.OPTIMIZE  9+6
UNIT V  MATHEMATICAL MODELING AND SOLVING USING PYOMO  9+6
Mathematical modeling – Overview of modeling components and processes – Abstract vs Concrete models – Simple abstract pyomo model – simple concrete pyomo model – Solving simple examples

OUTCOMES:
Upon completion of the course, the student will be able to
• Design solutions using python classes and objects.
• Mathematically model real time problems and solve using python packages.
• Identify and apply suitable python functions for a given problem.
• Apply the knowledge of optimization techniques and create solutions to complex engineering problems using python.
• Demonstrate skill in development of optimization solvers and synthesis of the information to provide valid inferences.

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OR5002 SYSTEMS MODELLING AND SIMULATION  L T P C

OBJECTIVES:
• To introduce the characteristics of system modelling and the importance of simulation.
• To study the various approaches of modelling.
• To model the solutions using queueing theory.
• To teach the generation of data for simulation.
• To study the various system models and familiarize the simulation tools.
UNIT I  INTRODUCTION
System definition - Types and characteristics - Need for modelling and simulation - Types of Simulation - Introduction to discrete event simulation - Single server - Multiserver Exercises - System modelling - Simple Petrinets

UNIT II  MODELLING APPROACHES
Modelling concurrent systems - Analysis of Petrinets - Finite state Automata and Regular Expressions - Relationship - FSA with silent transitions - Pumping lemma for regular sets - Analysis using DFS and model checking.

UNIT III  QUEUING MODELS
Characteristics of queuing systems - Notations - Types of Queues - Markovian model - Non-Markovian model - Queuing Networks - Applications of queuing systems.

UNIT IV  SIMULATION DATA
Methods for generating random numbers - Testing of random numbers - Methods of generating random variants - Problem formulation - input modelling - Verification and Validation - Output Analysis.

UNIT V  CASE STUDY
NS2 - Simulation of Computer Systems - Simulation of Computer Networks - Simulation of Mobile Networks - Simulation of Manufacturing and Material Handling Systems

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- Understand the characteristics of system modelling and the importance of simulation.
- Design system model using various approaches.
- Apply queuing theory to various systems.
- Generate data for simulation.
- Model and analyse a given system using simulation tools.

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OBJECTIVES:
- To understand the concept of project planning and scheduling.
- To explore the different alternative schedules to complete a project.
- To study the effect of uncertainty in project completion.
- To find out the optimum cost effective project completion plan.
- To solve the limited resources network scheduling problems using Heuristic methods.

UNIT I  INTRODUCTION

UNIT II  ALGORITHMS FOR CRITICAL PATH
Finding the critical path – Multiple critical paths – Job slack – Algorithm for finding the critical path – Late start and Late finish times – Total slack – Free slack – project due dates that differ from earliest completion time – A digression on stack – Back to the contractor.

UNIT III  PERT MODEL

UNIT IV  COST ANALYSIS
PERT/ cost : A network cost accounting system - Basic concepts of Network Cost Systems - cost accounting by work packages - forecast of project costs - Analysis and control of project costs - Graphic displays of cost and time data - cost curve for activities and departments - possible accounting problems with PERT/cost.

UNIT V  HEURISTIC APPROACHES
Network scheduling with limited resources-The complexity of project scheduling with limited resources - Heuristic programs - Heuristic methods for resource leveling of project schedules - Example of a resource leveling programs - Heuristic methods for resource allocation in project scheduling- A simple heuristic program - The SPAR-1 resource allocation model - Conceptual problems of critical path analysis when resources are limited - Slack in a limited resource schedule-projects with uncertain activity estimates - planning versus scheduling - conclusion.

OUTCOMES:
Upon completion of the course, the students will be able to
- Conceptually understand the project elements, activities and its effect on project planning.
- Identify the critical activities.
- Identify parallel activities.
- Create a project scheduling incorporating all critical values.
- Optimize effectively through complementary tools.
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OR5004 DYNAMIC PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:
- To analyse systems and devise methods for optimal and efficient results.
- To formulate dynamic programming problems and analyse its characteristics.
- To apply principle of optimality with deterministic approaches like recursion.
- To apply the markov chaining models in dynamic programming.
- To solve risk and uncertainty problems using dynamic programming.

UNIT I INTRODUCTION AND APPLICATIONS OF DYNAMIC PROGRAMMING 9

UNIT II DETERMINISTIC DYNAMIC PROGRAMMING 9
UNIT III  PROBABILISTIC DYNAMIC PROGRAMMING  9

UNIT IV  DYNAMIC PROGRAMMING IN MARKOV CHAINS  9

UNIT V  RISK AND UNCERTAINTY  9

OUTCOMES:
Upon completion of the course, the students will be able to

- Identify and formulate dynamic programming problems and also comprehend characteristics of dynamic programming problems.
- Analyse and solve deterministic dynamic programming problems.
- Analyse the computational feasibility and solve multi-stage stochastic dynamic programming problems using known efficient methods.
- Understand and apply HMM models.
- Design and solve decision making problems under risk.

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OBJECTIVES:
- To study the basics of scheduling theory in real time.
- To model solution to single machine scheduling problems.
- To formulate solution to parallel machine scheduling.
- To solve flow shop scheduling using various algorithms.
- To study the various tools and algorithms for job shop scheduling.

UNIT I  SCHEDULING THEORY 9

UNIT II  SINGLE MACHINE SCHEDULING 9

UNIT III  PARALLEL MACHINE SCHEDULING 9

UNIT IV  FLOW SHOP SCHEDULING 9

UNIT V  JOB SHOP SCHEDULING 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- Understand the basics of scheduling theory in real time.
- Model solution to single machine scheduling problems.
- Formulate solution to parallel machine scheduling.
- Solve flow shop scheduling using various algorithms.
- Study the various tools and algorithms for job shop scheduling.

REFERENCES:
OR5006  NETWORK OPTIMIZATION  L T P C  
3 0 0 3

OBJECTIVES:
- To analyse network characteristics and identify optimization parameters.
- To apply optimization techniques to solve shortest path problems.
- To formulate network optimization problem as nonlinear optimization problem and solve using convex optimization solution methods.
- To apply integer constrained optimization methods to network problem.
- To study the various network flow models and network simulation tools.

UNIT I  INTRODUCTION

UNIT II  SHORTEST PATH PROBLEMS
Shortest path problems - max-flow problem - min-cost flow problem - Simplex methods for min-cost flow - Dual ascent methods for min-cost flow.

UNIT III  NON-LINEAR NETWORK OPTIMIZATION

UNIT IV  INTEGER CONTRAINTS NETWORK PROBLEMS

UNIT V  CASE STUDIES
Nature inspired algorithms - Optimization as markov chains - TCP modeling - solving optimization problems using NS3/OPNET/QUALNET.

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of the course, the students will be able to

- Apply the knowledge of optimization techniques in computer networks.
- Design solutions to flow problems in real time networks.
- Formulate network problems as optimization problems and obtain optimal solutions.
- Apply linear, nonlinear and integer programming techniques to network problems.
- Develop and test algorithms using simulation tools.

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OR5007 SUPPLY CHAIN MANAGEMENT

OBJECTIVES:
- To familiarize the management of supply chain assembly.
- To forecast supply and demand.
- To learn about the capability of Inventory management, planning and decision making.
- To devise network planning and procurement strategy.
- To study the role of IT in Supply chain management.

UNIT I INTRODUCTION
UNIT II FORECASTING

UNIT III INVENTORY MANAGEMENT AND RISK POOLING

UNIT IV NETWORK PLANNING AND PROCUREMENT STRATEGY

UNIT V INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT
Enabling supply chain through IT – ERP vendor platforms – Service oriented architecture (SOA) – RFID

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Understand the management of supply chain assembly.
- Forecast the demand and plan for supply.
- Manage large inventory system with various system approaches.
- Acquire knowledge in planning and procurement strategies.
- Apply IT solutions like ERP & SOA to manage supply chain.

REFERENCES:
OBJECTIVES:
- To identify and formulate convex and concave optimization problems.
- To conceptualize the real life applications in terms of convex problems and identify appropriate algorithm to solve them.
- To analyse duality, sensitivity and optimality conditions.
- To solve unconstrained convex optimization problems.
- To appreciate duality and interior point methods in solving convex optimization problems.

UNIT I INTRODUCTION

UNIT II CONVEX OPTIMIZATION PROBLEMS

UNIT III DUALITY

UNIT IV UNCONSTRAINED AND EQUALITY CONSTRAINED MINIMIZATION

UNIT V INTERIOR POINT METHODS

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Identify and mathematically formulate convex optimization problems.
- Solve constrained and unconstrained optimization problems by identifying and using various algorithms.
- Understand duality and interior point methods in solving convex optimization problems.
- Apply the concepts of convex optimization in real life scenarios.
- Provide inferences from the obtained solutions to aid planning and decision making.

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**OR5009 NUMERICAL OPTIMIZATION**

**OBJECTIVES:**
- To create mathematical formulations and apply solutions using level and convex sets.
- To analyse the performance and complexity issues of various algorithms for finding optimal solutions.
- To solve unconstrained optimization problems using basic descent methods.
- To understand the characteristics of constrained optimization problems and methods to solve them.
- To identify appropriate numerical optimization technique to solve real time complex engineering problems.

**UNIT I INTRODUCTION**

**UNIT II COMPLEXITY ISSUES**

**UNIT III UNCONSTRAINED OPTIMIZATION**

**UNIT IV CONSTRAINED OPTIMIZATION**

**UNIT V CASE STUDIES**

**TOTAL: 45 PERIODS**
OUTCOMES:
Upon completion of the course, the students will be able to

- Formulate and analyse the existence of solutions to optimization problems.
- Understand the basics of linear programming, unconstrained and constrained optimization.
- Analyse the stability, order of convergence and conditions of application of techniques.
- Solve unconstrained and constrained optimization problems.
- Apply the knowledge of numerical optimization techniques to complex engineering problems and provide inferences from the obtained solutions to aid planning and decision making.

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OR5010 QUEUEING THEORY AND STOCHASTIC PROCESS 3 0 0 3

OBJECTIVES:
- To review the basics of probability distributions.
- To review the stochastic processes and its applications.
- To appreciate the classification and application of random process.
- To formulate and model systems using queueing models.
- To model, simulate and solve systems to improve performance.

UNIT I RANDOM VARIABLES
Discrete And Continuous Random Variables – Moments – Moment Generating Functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma And Normal Distributions.
UNIT II  INTRODUCTION TO STOCHASTIC PROCESSES (SP)  9
Definition and examples of SPs, classification of random processes according to state space and parameter space, types of SPs, elementary problems

UNIT III  RANDOM PROCESSES  9

UNIT IV  QUEUEING MODELS  9

UNIT V  ADVANCED QUEUEING MODELS  9
Finite Source Models – M/G/1 Queue – PollaczekKhinchin Formula – M/D/1 And M/EK/1 As Special Cases – Series Queues – Open Jackson Networks.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- Demonstrate a fundamental knowledge of queuing theory based modelling.
- Appreciate the application of stochastic processes.
- Understand various stationary and random processes.
- Analyse and solve engineering problems using queuing models.
- Design and formulate advance queuing models like series queues and Jackson networks.

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OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I  OVERVIEW OF BUSINESS ANALYTICS  9

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS  9

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE  9

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.
Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real-time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK


Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web-based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS

Overview of Application development Languages for Hadoop – Pig Latin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig.
- Practical – Write Pig Latin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real-time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real-world business problems and model with analytical solutions.
- Solve analytical problems with relevant mathematics background knowledge.
- Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing.
- Write and demonstrate simple applications involving analytics using Hadoop and MapReduce.
- Use open-source frameworks for modeling and storing data.
- Apply suitable visualization techniques using R for visualizing voluminous data.

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OE5092  INDUSTRIAL SAFETY  LT P C
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OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

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

UNIT II  FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

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

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

OUTCOMES:
Students will be able to:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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OE5093 OPERATIONS RESEARCH

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method
UNIT II ADVANCES IN LINEAR PROGRAMMING 9
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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OBJECTIVES:
Summarize the costing concepts and their role in decision making
Infer the project management concepts and their various aspects in selection
Interpret costing concepts with project execution
Develop knowledge of costing techniques in service sector and various budgetary control techniques
Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.
UNIT II           INTRODUCTION TO PROJECT MANAGEMENT
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.

UNIT III           PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV           COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V           QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I

INTRODUCTION

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

UNIT II

REINFORCEMENTS

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

UNIT III

MANUFACTURING OF METAL MATRIX COMPOSITES


UNIT IV

MANUFACTURING OF POLYMER MATRIX COMPOSITES


UNIT V

STRENGTH

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

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OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION

UNIT IV BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features
REFERENCES:

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
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, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
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 V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS
OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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AX5092 DISASTER MANAGEMENT L T P C
2000

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
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

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6
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.
UNIT V  RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093  SANSKRIT FOR TECHNICAL KNOWLEDGE  L T P C
2 0 0 0

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I  ALPHABETS
Alphabets in Sanskrit

UNIT II  TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III  ORDER AND ROOTS
Order - Introduction of roots
UNIT IV  SANSKRIT LITERATURE  6
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

OUTCOMES
• CO1 - Understanding basic Sanskrit language.
• CO2 - Write sentences.
• CO3 - Know the order and roots of Sanskrit.
• CO4 - Know about technical information about Sanskrit literature.
• CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbashstri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094  VALUE EDUCATION  L T P C  2 0 0 0

OBJECTIVES
Students will be able to
• Understand value of education and self-development
• Imbibe good values in students
• Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS
OUTCOMES
Students will be able to
• Knowledge of self-development.
• Learn the importance of Human values.
• Developing the overall personality.

SUGGESTED READING

AX5095  CONSTITUTION OF INDIA  L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
• Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
• 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 nation hood in the early years of Indian nationalism.
• 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.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee. (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV  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 V  LOCAL ADMINISTRATION:

UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS
OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.

AX5096 PEDAGOGY STUDIES  
OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy.
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

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.

UNIT II  THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III  EVIDENCE ON THE EFFECTIVENESS OF PEDAGOOGICAL 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.
UNIT IV PROFESSIONAL DEVELOPMENT
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

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers in informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practice) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097 STRESS MANAGEMENT BY YOGA

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga (Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.
UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama
   (Publication Department), Kolkata

AX5098
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010