PROGRAM EDUCATIONAL OBJECTIVES:
1. Prepare students to review and understand foundational concepts in Computer Science and Engineering
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 the interaction between 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 engineering solutions and optimization techniques within a global, societal, and environmental context by solving the problem faced by the people to alleviate the society of hardship.

PROGRAM OUTCOMES:
Students will be able to:

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer based systems of varying complexity
b. Critically analyze problems which prove to be impediment to the development of society, identify and formulate solution by applying Operations Research and Computer Science and Engineering techniques considering current and future trends.
c. Acquire leadership and managerial capabilities in decision making, analysing the alterable and managing the assets
d. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability.
e. Function effectively on teams to accomplish a common goal
f. Communicate effectively with a range of audiences and prepare technical documents and make effective oral presentations
g. Critically analyse existing literature in the area(s) of specialization and develop innovative and research oriented methodologies to tackle the identified gaps
h. Recognize the need for and possess an ability to engage in lifelong learning continuing professional development
i. Have ability to develop systems using software tools
j. Demonstrate the knowledge gained in the selected areas of Computer Engineering and Operations Research.
## 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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### VI Semester

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**TOTAL NO. OF CREDITS: 73**
### FOUNDATION COURSES (FC)

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### PROFESSIONAL ELECTIVES (PE)

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<td>Adhoc and Wireless Sensor Networks</td>
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CFAA, Director
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<td>CP7091</td>
<td>Service Oriented Architecture and Design</td>
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<td>CP7095</td>
<td>Virtualization Techniques and Applications</td>
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**OPERATIONS RESEARCH ELECTIVES**

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<td>SO7002</td>
<td>Business Process Management</td>
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<td>SO7008</td>
<td>System Modelling and Simulation</td>
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<td>SO7103</td>
<td>Principles of Systems Engineering</td>
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<td>SO7201</td>
<td>Supply Chain Management</td>
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<td>OR7001</td>
<td>Python Programming for Operations Research Applications</td>
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<td>OR7002</td>
<td>Statistical Quality Control</td>
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<td>Scheduling Algorithms</td>
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<td>SO7003</td>
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<td>Java Programming and Operations Research Applications</td>
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A minimum of 3 of 5 electives have to necessarily be chosen from the list of “Operations Research Electives”
## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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Project work must be carried out in the area of Operations Research.
OBJECTIVES:
- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queueing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems.

UNIT I  RANDOM VARIABLES

UNIT II  QUEUING MODELS

UNIT III  SIMULATION
Discrete Event Simulation – Monte Carlo Simulation – Stochastic Simulation – Applications to Queuing systems.

UNIT IV  TESTING OF HYPOTHESIS
Sampling distributions – Estimation of parameters - Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion.

UNIT V  LINEAR PROGRAMMING

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of the course, the student will be able to
- Identify the type of random variable and distribution for a given operational conditions/scene
- Study and Design appropriate queuing model for a given problem/system situation
- Simulate appropriate application/distribution problems
- Differentiate/infer the merit of sampling tests.
- Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.

REFERENCES:
OBJECTIVES:

- To extend the students’ knowledge of algorithms and data structures
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To learn a variety of useful algorithms and techniques
- To extrapolate from them in order to apply those algorithms and techniques to solve problems

UNIT I  FUNDAMENTALS  9

UNIT II  HEAP STRUCTURES  9
Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy-Binomial Heaps

UNIT III  SEARCH STRUCTURES  9

UNIT IV  GEOMETRIC ALGORITHMS  9

UNIT V  PARALLEL ALGORITHMS  9
Flynn’s Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication – Data Distribution on EREW, Mesh and Butterfly

TOTAL : 45 PERIODS

OUTCOMES
Upon completion of this course, the student should be able to

- Have a basic ability to analyze algorithms and to determine algorithm correctness and time efficiency
- Master a variety of advanced data structures and their implementations and different algorithm design techniques in computational geometry and in parallel algorithms
- Apply and implement the learnt algorithm design techniques and data structures to solve problems

REFERENCES
OBJECTIVES:

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re-engineering

UNIT I  SOFTWARE ENGINEERING PROCESS AND FORMAL METHODS  9

UNIT II  AGILE AND ASPECT ORIENTED SOFTWARE ENGINEERING  9

UNIT III  COMPONENT-BASED SOFTWARE ENGINEERING  9
Engineering of component-based systems, the CBSE process – Designing class based components – component design for WebApps – Component-based development – Component-level design patterns – Classifying and retrieving components, and economics of CBSE.

UNIT IV  ADVANCED SOFTWARE TESTING TECHNIQUES  9

UNIT V  SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING  9

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

- Analytically apply general principles of software development in the development of complex software and software-intensive systems
- Discuss methods and techniques for advanced software development and also to be able to use these in various development situations
- Apply testing techniques for object oriented software and web-based systems
REFERENCES:

CP7153 ADVANCES IN 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 mobile and real-time operating systems
- To gain knowledge on the design concepts of mainframe operating systems

UNIT I BASICS OF OPERATING SYSTEMS

UNIT II DISTRIBUTED OPERATING SYSTEMS

UNIT III DISTRIBUTED RESOURCE MANAGEMENT

UNIT IV MOBILE AND REAL TIME OPERATING SYSTEMS
UNIT V MAINFRAME AND LINUX OPERATING SYSTEMS


TOTAL : 45 PERIODS

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

- Demonstrate the various protocols of distributed operating systems
- Identify the different features of mobile and real-time operating systems
- Discuss the various features of mainframe operating systems

REFERENCES:

SO7102 LINEAR PROGRAMMING AND APPLICATIONS

OBJECTIVES:
- To introduce the basic concepts and tools in optimization.
- To explore the advanced concepts vertically to get clear understanding and to apply the concepts in engineering and scientific applications.

UNIT I INTRODUCTION

UNIT II ADVANCED LINEAR PROGRAMMING

UNIT III SENSITIVITY ANALYSIS
Sensitivity Analysis or Post Optimality Analysis – Changes in the Right hand side – 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.

TOTAL: 75 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Conceptually understand and emerge toward optimization.
- Optimize effectively through LP methods and solve using R programming.

REFERENCES:

CP7161  ADVANCED DATA STRUCTURES AND ALGORITHMS LAB  L  T  P  C
0  0  4  2

OBJECTIVES:
- To understand heap and various tree structures like AVL, Red-black, B and Segment trees
- To understand the problems such as line segment intersection, convex shell and Voronoi diagram

Experiments to construct and manipulate the following:
1. Min/Max Heap
2. Leftist Heap
3. AVL Trees
4. Red-Black Trees
5. B-Trees
6. Segment Trees
7. Line segment intersection
8. Convex Hull
9. Voronoi Diagram

TOTAL : 60 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Implement heap and various tree structure like AVL, Red-black, B and Segment trees
- Solve the problems such as line segment intersection, convex shell and Voronoi diagram
CP7162  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

Identify an application (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

OUTCOMES:
Upon completion of this course, the student should 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

TOTAL : 30 PERIODS

CP7155  NETWORKING TECHNOLOGIES  L  T  P  C
3  0  3

OBJECTIVES

- To learn about integrated and differentiated services architectures
- To understand the working of wireless network protocols
- To study the evolution made in cellular networks
- To get familiarized with next generation networks

UNIT I  NETWORK ARCHITECTURE AND QoS  9

UNIT II  WIRELESS NETWORKS  9

UNIT III  CELLULAR NETWORKS  9
UNIT IV  4G NETWORKS

UNIT V  SOFTWARE DEFINED NETWORKS

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Identify the different features of integrated and differentiated services
- Demonstrate various protocols of wireless and cellular networks
- Discuss the features of 4G and 5G networks

REFERENCES:

CP7253  MACHINE LEARNING TECHNIQUES

OBJECTIVES
- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To understand the theoretical and practical aspects of Probabilistic Graphical Models
- To appreciate the concepts and algorithms of reinforcement learning
- To learn aspects of computational learning theory

UNIT I  INTRODUCTION
UNIT II SUPERVISED LEARNING 10+6

UNIT III UNSUPERVISED LEARNING 8+6

UNIT IV PROBABILISTIC GRAPHICAL MODELS 10+6
Graphical Models - Undirected graphical models - Markov Random Fields - Directed Graphical Models - Bayesian Networks - Conditional independence properties - Inference - Learning - Generalization - Hidden Markov Models - Conditional random fields (CRFs)

UNIT V ADVANCED LEARNING 9+6

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- 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 introduce and familiarize non-linear approaches in optimization.
- To conceptualize the real life applications in terms of non-linearity and also to learn MATLAB for solving the same.

UNIT I  
INTRODUCTION


UNIT II  
ONE DIMENSIONAL OPTIMIZATION


UNIT III  
MULTI-DIMENSIONAL OPTIMIZATION


UNIT IV  
UNCONSTRAINED OPTIMIZATION FOR CONSTRAINED PROBLEMS


UNIT V  
EVOLUTIONARY PROGRAMMING


OUTCOMES:

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

- Applying the concepts of non-linear programming in real life scenarios.
- Provide instant results through MATLAB.

REFERENCES:

OBJECTIVES:

- To understand the underlying principles of Relational Database Management System.
- To understand and implement the advanced features of DBMS.
- To develop database models using distributed databases.
- To implement and maintain an efficient database system using emerging trends.

UNIT I RELATIONAL MODEL


UNIT II PARALLEL AND DISTRIBUTED DATABASES


UNIT III XML DATABASES


UNIT IV MULTIMEDIA DATABASES


UNIT V CURRENT ISSUES

Active Databases – Deductive Databases – Data Warehousing – Data Mining – Database Tuning – Database Security

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design and implement relational databases, distributed databases, XML databases and multimedia databases.
- Implement the concept of database connectivity with the applications.

REFERENCES:

SO7211 ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

OBJECTIVES:

SOFTWARE:
Oracle 10 G or Higher / Equivalent

TOPICS TO BE COVERED:
1. Data Definition Language
   - Create, Alter, Drop, Truncate, Comment, Rename Command Enforcing Integrity Constraints Views, Synonyms, Sequences, Indexes
2. DML Operations
3. Joining Data from Multiple Tables in Queries
   - The join Condition / The Cartesian Product Equijoin, Self-join, Outer joins
4. Set Operations
5. Aggregate Functions and the GROUP By Clause
6. Using Sub-queries
7. Analytic Functions
8. Introduction to Procedures and Functions
   - Creating stored PL / SQL objects, procedures, functions
9. Creating Packages
10. Creating package specifications and bodies
11. Creating DML Triggers
   - Triggering events, Trigger behavior
   - Correlation identifiers, Multi-statement triggers
   - Trigger firing behavior, Enabling / Disabling triggers
12. Distributed Database Implementation

TOTAL : 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Design and implement relational database.
- Perform all the query manipulation operations and procedural querying language.
- Design and develop active and distributed databases.

OR7301 PROJECT MANAGEMENT WITH PERT/CPM

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.

UNIT I
PERT and CPM come of age – planning scheduling and control planning - scheduling networks – The activity – Node Diagram – Building a house – Network scheduling
UNIT II
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

UNIT IV
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
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.

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:
Upon completing this 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

REFERENCES:
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 security issues in ad hoc and sensor networks and solutions to the issues

UNIT I MAC & ROUTING IN AD HOC NETWORKS

UNIT II TRANSPORT & QOS IN AD HOC NETWORKS

UNIT III MAC & ROUTING IN WIRELESS SENSOR NETWORKS

UNIT IV TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Identify different issues in wireless ad hoc and sensor networks
- Analyze protocols developed for ad hoc and sensor networks
- Identify different issues in wireless ad hoc and sensor networks
- Identify and critique security issues in ad hoc and sensor networks

REFERENCES:

CP7077 DATABASE ADMINISTRATION AND TUNING  
OBJECTIVES
- To design and implement relational database solutions for general applications
- To develop database scripts for data manipulation and database administration
- To understand and perform common database administration tasks such as database monitoring, performance tuning, data transfer, and security
- To balance the different types of competing resources in the database environment so that the most important applications have priority access to the resources

UNIT I INTRODUCTION TO DATABASE ADMINISTRATION
Database Administration - DBA Tasks - DBMS Release Migration - Types of DBAs - Creating the Database Environment – Defining the organizations DBMS strategy - Installing the DBMS - Upgrading DBMS Versions and Releases

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY

UNIT III FUNDAMENTALS OF TUNING

UNIT IV INDEX TUNING AND QUERY OPTIMIZATION

UNIT V TROUBLESHOOTING

OUTCOMES:
Upon completion of this course, the student should be able to
- Apply advanced features of databases in design, administration, and applications
- Provide techniques to improve the performance of a database
- Optimize the use of existing resources within the database environment

TOTAL : 45 PERIODS

25
REFERENCES:

CP7080 ETHICAL HACKING

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 get familiarized with the different phases in penetration testing

UNIT I  INTRODUCTION TO HACKING  9

UNIT II  SCANNING AND ENUMERATION  9

UNIT III  SYSTEM HACKING  9

UNIT IV  PROGRAMMING FOR SECURITY PROFESSIONALS  9

UNIT V  PENETRATION TESTING  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Defend hacking attacks and 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
REFERENCES:

CP7081 FAULT TOLERANT SYSTEMS

OBJECTIVES:
- To provide and appreciate a comprehensive view of fault tolerant systems
- To expose the students to the methods of hardware fault tolerance
- To understand the different ways of providing information redundancy and the ways of providing software fault tolerance.
- To expose the students to concept of check pointing and their role in providing fault tolerance.
- To understand how to handle security attacks.

UNIT I INTRODUCTION 9
Fault Classification, Types of Redundancy, Basic Measures of Fault Tolerance, Hardware Fault Tolerance, The Rate of Hardware Failures, Failure Rate, Reliability, and Mean Time to Failure, Canonical and Resilient Structures, Other Reliability Evaluation Techniques, Processor level Techniques

UNIT II INFORMATION REDUNDANCY 9

UNIT III SOFTWARE FAULT TOLERANCE 9

UNIT IV CHECKPOINTING 9

UNIT V FAULT DETECTION IN CRYPTOGRAPHIC SYSTEMS 9

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to
• Define the traditional measures of fault tolerance
• Point out the processor level fault tolerance techniques
• Critically analyze the different types of RAID levels
• Discuss techniques like recovery blocks and N-version programming
• Identify techniques for check pointing in distributed and shared memory systems.
• Provide techniques to detect injected faults in ciphers.

REFERENCES:

CP7084 MODELS OF COMPUTATIONS

OBJECTIVES
• To understand computation and computability concepts.
• To study different approaches to facilitate computing
• To learn the abstractions of computation and their implementations

UNIT I TURING MACHINE MODEL
Turing Machine Logic, Proof, Computability

UNIT II QUANTUM COMPUTATION
Quantum Computing History, Postulates of Quantum Theory, Dirac Notation, the Quantum Circuit Model, Simple Quantum Protocols: Teleportation, Superdense Coding, Foundation Algorithms

UNIT III NATURE INSPIRED COMPUTING
Nature-Inspired Computing Optimization and Decision Support Techniques, Evolutionary Algorithms, Swarm Intelligence, Benchmarks and Testing

UNIT IV SOCIAL COMPUTING
Social Computing Online communities, Online discussions, Twitter, Social Networking Systems, Web 2.0, social media, Crowd sourcing, Facebook, blogs, wikis, social recommendations, Collective intelligence

UNIT V EVOLUTIONARY COMPUTING

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to
- Identify the terminology of the theory of computing
- Predict the major results in computability and complexity theory.
- Prepare the major models of computations

REFERENCES:

CP7087 PARALLEL ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:
- To learn parallel algorithms development techniques for shared memory and DCM models
- To study the main classes of fundamental parallel algorithms
- To study the complexity and correctness models for parallel algorithms.

UNIT I INTRODUCTION 9

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

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 this course, the student should be able to
- Familiarize with design of parallel algorithms in various models of parallel computation
- Familiarize with the efficient parallel algorithms related to many areas of computer science: expression computation, sorting, graph-theoretic problems, computational geometry, etc
- Familiarize with the basic issues of implementing parallel algorithms
REFERENCES:

CP7088 PARALLEL AND DISTRIBUTED DATABASES   LT PC
                                     3 0 0 3

OBJECTIVES:
- To realize the need of parallel processing
- To cater to applications that require a system capable of sustaining trillions of operations per second on very large data sets
- To understand the need of data integration over data centralization

UNIT I   INTRODUCTION TO PARALLEL DATABASES   9
Need of Parallelism - Forms of parallelism – architecture – Analytical models. Basic Query
Parallelism – Parallel Search- Parallel sort and Group By- Parallel Join

UNIT II  ADVANCED QUERY PROCESSING IN PARALLEL DATABASES   9
Parallel indexing. Parallel Universal Qualification – Collection Join Queries. Parallel Query
Scheduling – Optimization, Applications

UNIT III  INTRODUCTION TO DISTRIBUTED DATABASES   9
Overview - Promises of DDB –Design Issues – DDB Design – DDB Integration – Data and
Access Control

UNIT IV  QUERY PROCESSING IN DISTRIBUTED DATABASES   9
Overview- of Query Processing – Query Decomposition and Data Localization – Optimization
of Distributed Queries, Multi-database Query Processing

UNIT V  TRANSACTION MANAGEMENT AND OTHER ADVANCED SYSTEMS  9
Introduction – Concurrency Control - Distributed DBMS Reliability – Data Replication – DDB
Applications, Distributed Object Database Management – Peer -to-Peer Data Management –
Web Data Management – Streaming Data and Cloud Computing

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Get good knowledge on the need, issues, design and application of both parallel and
distributed databases
- Know how to write optimal queries to cater to applications that need these forms of
databases
- Fragment, replicate and localize their data as well as their queries to get their work done
closer
- Get idea on other similar trends of optimal data processing
REFERENCES:

CP7089 REAL TIME SYSTEMS DESIGN

OBJECTIVES:
- To learn real time operating system concepts and the associated issues & techniques.
- To understand design and synchronization problems in Real Time System.
- To understand the evaluation techniques present in Real Time System.

UNIT I REAL TIME SPECIFICATION AND DESIGN TECHNIQUES

UNIT II SOFTWARE REQUIREMENTS ENGINEERING

UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT

UNIT IV REAL TIME DATABASES
Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems

UNIT V PROGRAMMING LANGUAGES

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to
- Apply principles of real time systems design.
- Make use of architectures and behavior of real time operating systems and database in real time applications.

REFERENCES:

CP7090 SECURE NETWORK SYSTEM DESIGN

OBJECTIVES:
- To understand best security practices and how to take advantage of the networking gear that is already available
- To learn design considerations for device hardening, Layer 2 and Layer 3 security issues, denial of service, IPSec VPNs, and network identity
- To understand security design considerations for common applications such as DNS, mail and web
- To identify the key security roles and placement issues for network security elements such as firewalls, intrusion detection systems, VPN gateways, content filtering, as well as for traditional network infrastructure devices such as routers and switches
- To understand the various testing and optimizations strategies to select the technologies and devices for secure network design

UNIT I NETWORK SECURITY FOUNDATIONS
Secure network design through modeling and simulation, A fundamental framework for network security, need for user level security on demand, Network Security Axioms, security policies and operations life cycle, security networking threats, network security technologies, general and identity design considerations, network security platform options and best deployment practices, secure network management and network security management

UNIT II IDENTIFYING SYSTEM DESIGNER’S NEEDS AND GOALS
Evolution of network security and lessons learned from history, Analyzing top-down network design methodologies, technical goals and tradeoffs – scalability, reliability, availability, Network performance, security, Characterizing the existing internetwork, characterizing network traffic, developing network security strategies

UNIT III PHYSICAL SECURITY ISSUES AND LAYER 2 SECURITY
Control physical access to facilities, Control physical access to data centers, Separate identity mechanisms for insecure locations, Prevent password-recovery mechanisms in insecure locations, awareness about cable plant issues, electromagnetic radiation and physical PC security threats, L2 control protocols, MAC flooding considerations, attack mitigations, VLAN hopping attacks, ARP, DHCP, PVLAN security considerations, L2 best practice policies
UNIT IV  IP ADDRESSING AND ROUTING DESIGN CONSIDERATIONS  9
Route summarizations, ingress and egress filtering, Non routable networks, ICMP traffic management, Routing protocol security, Routing protocol authentication, transport protocol management policies, Network DoS/flooding attacks

UNIT V  TESTING AND OPTIMIZING SYSTEM DESIGN  9
Selecting technologies and devices for network design, testing network design – using industry tests, building a prototype network system, writing and implementing test plan, tools for testing, optimizing network design – network performance to meet quality of service (QoS), Modeling, simulation and behavior analysis of security attacks, future issues in information system security

OUTCOMES:
Upon completion of this course, the student should be able to
- Follow the best practices to understand the basic needs to design secure network
- Satisfy the need for user and physical level security on demand for various types of network attacks
- Use best practice policies for different network layer protocols
- Understand the network analysis, simulation, testing and optimizing of security attacks to provide Quality of Service

REFERENCES:

CP7091  SERVICE ORIENTED ARCHITECTURE AND DESIGN  L T P C
3 0 0 3

OBJECTIVES:
- To understand the SOA architecture
- To understand the service oriented analysis and design
- To understand the development of deployment of web services
- To understand the security issues of SOA

UNIT I  SOA FUNDAMENTALS  9

UNIT II  SOA AND WEB SERVICES  9
UNIT III SERVICE ORIENTED ANALYSIS AND DESIGN 9
Design principles - Business Centric SOA - Deriving Business services - Service Modeling - Coordination - Atomic Transaction - Business activities - Web Service Orchestration Business Process Execution Language (BPEL) - Choreography - Metadata Management- Entity centric business service design - Application Service design - Task centric business service design

UNIT IV WEB SERVICES DEVELOPMENT AND DEPLOYMENT 9
XML and Web Services - WSDL basics - SOA support in J2EE - Java API for XML-based Web Services (JAX-WS) - Java Architecture for XML Binding (JAXB) - Java API for XML Registries (JAXR) - Web Services Interoperability Technologies - SOA support in .NET - Common Language Runtime - ASP.NET - Web forms - ASP.NET Web Services - Web Services Enhancements

UNIT V SOA APPLICATIONS AND SECURITY 9

OUTCOMES:
Upon completion of this course, the student should be able to
- Develop and deploy simple and composite web services with SOA design principles considering the security issues
- Understand and describe the standards and technologies of modern web service implementations
- Efficiently use leading development tools to create and consume web services
- Implement a service oriented application

REFERENCES:

CP7095 VIRTUALIZATION TECHNIQUES AND APPLICATIONS  L T P C
3 0 0 3
OBJECTIVES:
- To understand the concepts of virtualization and virtual machines
- To understand the implementation of process and system virtual machines
- To explore the aspects of high level language virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions

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UNIT I  OVERVIEW OF VIRTUALIZATION 9

UNIT II  PROCESS VIRTUAL MACHINES 9

UNIT III  HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION 9
HLL virtual machines: Pascal P-Code – Object Oriented HLLVMs - Java VM architecture - Java Native Interface - Common Language Infrastructure. Server virtualization: Partitioning techniques - virtual hardware - uses of virtual servers - server virtualization platforms

UNIT IV  NETWORK AND STORAGE VIRTUALIZATION 9

UNIT V  APPLYING VIRTUALIZATION 9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Deploy legacy OS on virtual machines.
- Analyze the intricacies of server, storage and network virtualizations
- Design and develop applications on virtual machine platforms

REFERENCES:
OBJECTIVES

- To understand different forms of intermediate languages and analyzing 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

UNIT II  LOCAL AND LOOP OPTIMIZATIONS  9

UNIT III  PROCEDURE OPTIMIZATION AND SCHEDULING  9

UNIT IV  INTER PROCEDURAL OPTIMIZATION  9

UNIT V  OPTIMIZING FOR MEMORY  9
Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should 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
- Ensure better utilization of resources
REFERENCES:

IF 7004 BUILDING INTERNET OF THINGS

OBJECTIVES:
- To understand the fundamentals of Internet of Things.
- To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To apply the concept of Internet of Things in the real world scenario

UNIT I FUNDAMENTALS OF IOT
Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoTvs M2M.

UNIT II IOT DESIGN METHODOLOGY
IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

UNIT III BUILDING IOT WITH RASPBERRY PI
Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services–

UNIT IV BUILDING IOT WITH GALILEO/ARDUINO
Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks

UNIT V CASE STUDIES and ADVANCED TOPICS
Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
- Develop web services to access/control IoT devices.
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario
REFERENCES:

IF7071 BIO INFORMATICS

OBJECTIVE:
- To learn bio-informatics algorithms

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the student should be able
- To design and implement bio-informatics algorithms.
REFERENCES:

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OBJECTIVES:
- To know the fundamental concepts of data science and analytics
- To learn various techniques for mining data streams
- To learn Event Modelling for different applications.
- To know about Hadoop and Map Reduce procedure

UNIT I INTRODUCTION TO DATA SCIENCE AND BIG DATA

UNIT II DATA ANALYSIS

UNIT III DATA MINING TECHNIQUES

UNIT IV MINING DATA STREAMS

UNIT V FRAMEWORKS AND VISUALIZATION

TOTAL : 45 + 30 = 75 PERIODS
OUTCOMES:
Upon the completion of the course the student should be able to
- Work with big data platform and its analysis techniques.
- Design efficient algorithms for mining the data from large volumes.
- Model a framework for Human Activity Recognition
- Development with cloud databases

REFERENCES:
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams
4. Jiawei Han, MichelineKamber “Data Mining Concepts and Techniques”, Second Edition,
8. S. N. Sivanandam, S. N Deepa, “Introduction to Neural Networks Using Matlab 6.0”, Tata

SO7004  DYNAMIC PROGRAMMING  L T P C
        3 0 0 3

OBJECTIVES:
- To make more specific linear and non-linear approaches that suits both stochastic and
  deterministic applications.
- To analyze systems to ensure optimal and faster results.

UNIT I  INTRODUCTION AND APPLICATIONS OF DYNAMIC
   PROGRAMMING 9
Characteristics of Dynamic Programming Problems – Formulation – Examples – Disadvantages
of Dynamic Programming – Bellman’s Principal of Optimality of Dynamic Programming – Applications
of Dynamic Programming—Capital Budgeting Problem – Reliability Improvement Problem (Shortest
path Problem) – Minimizing Scheduling problem – Optimal Subdividing Problem solution of LPP
through Dynamic Programming.

UNIT II  DETERMINISTIC DYNAMIC PROGRAMMING 9
Introduction – Mathematical description – Principal of Optimality – Recursive computation –
Multistage Forward and Backward Recursion – Selected Dynamic Programming Applications–
Cargo loading model – work force size model – equipment replacement model – investment model
– inventory models – Problem of Dimensionality.

UNIT III  PROBABILISTIC DYNAMIC PROGRAMMING 9
Introduction – Distribution of effort example – New product introduction, – Elementary inventory
model – optimal Batch size model – Stochastic regeneration Model–Equipment Replacement –
Sales Forecasting problem – Applicability and Computational feasibility.

UNIT IV  DYNAMIC PROGRAMMING IN MARKOV CHAINS 9
Introduction – Stochastic Shortest– Route Model – Unbounded horizon with discounting equivalent
Average Return – Linear Programming Approach – Computational considerations – Markov chain
version of the equipment replacement model.
UNIT V RISK AND UNCERTAINTY

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Discriminate the concepts of various optimization approaches.
- Choosing appropriate dynamic programming concept for a model.

REFERENCES:

SO7002 BUSINESS PROCESS MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
- To learn business process structure, framework and management.

UNIT I ORGANIZATIONAL STRUCTURE 9

UNIT II BUSINESS PROCESS MANAGEMENT 9

UNIT III THE FRAMEWORK - I 9

UNIT IV THE FRAMEWORK - II 9

UNIT V BPM AND THE ORGANIZATION 9
BPM maturity – BPM maturity model – Application of the BPMM model – Embedding BPM within the organization – Knowledge management and information technology – Process Modeling and formulation using a BPM suite in an organization as a case study.

TOTAL: 45 PERIODS
OUTCOMES:
Upon Completion of the course, the students will be able to:
- Understand the life cycle of a business process in an organization.
- Model and optimize the business process flow in an organization.

REFERENCES:

SO7008 SYSTEMS MODELLING AND SIMULATION

OBJECTIVES:
- To obtain sufficient knowledge to model any given system.
- To simulate the modeled system for performance study.

UNIT I INTRODUCTION
System definition -Types and characteristics -Need for modeling and simulation -Types of Simulation -Introduction to discrete event simulation -Single server -Multiserver Exercises -System modeling -Simple Petrinets

UNIT II MODELLING APPROACHES
Modeling 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 modeling -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 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Modeling any given system with rationality.
- Predicting the behavior through fine grained analysis.
REFERENCES:

SO7103 PRINCIPLES OF SYSTEMS ENGINEERING

OBJECTIVES:
• To introduce the concepts related to systems engineering with design, analysis, game theory and decision making analysis.

UNIT I SYSTEMS ENGINEERING PROCESSES

UNIT II ANALYSIS OF ALTERNATIVES

UNIT III STRUCTURAL MODEL & SYSTEM DYNAMICS

UNIT IV OPERATIONS RESEARCH AND SYSTEMS ENGINEERING

UNIT V DECISION MAKING AND DECISION ANALYSIS

OUTCOMES:
Upon completion of the course, the students will:
• Have the capability to design and analyze the system.
• Acquire decision making ability.
• Be familiar in system engineering design.
REFERENCES:

SO7201 SUPPLY CHAIN MANAGEMENT

OBJECTIVES:
- To familiarize the management of supply chain assembly and role of IT in it.
- To learn about the capability of Inventory management, planning and decision making.

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 CHAINS
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:
- Explain the management of supply chain assembly and role of IT in it.
- Capability of Inventory management, planning and decision making.
REFERENCES:

OR7001 PYTHON PROGRAMMING FOR OPERATIONS RESEARCH APPLICATIONS

OBJECTIVES:
- Students will learn the grammar of Python programming language.
- Students will understand the process and will acquire skills necessary to effectively attempt a Optimization problem and implement it with a specific programming language - Python.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO PYTHON

UNIT II PROGRAM ORGANIZATION AND FUNCTIONS
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
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

UNIT V MATHEMATICAL MODELING AND SOLVING USING PYOMO
Mathematical modeling – Overview of modeling components and processes – Abstract vs Concrete models – Simple abstract pyomo model – simple concrete pyomo model – Solving simple examples

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to
- Students will be able to develop skill in programming by learning Python.
- Students will attempt to solve mathematical optimization problems by programming.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent Trends in modeling optimization using Python.

REFERENCES:
1. Mark Lutz, "Learning Python, Powerful OOPs, O'reilly, 2011

OR7002 STATISTICAL QUALITY CONTROL L T P C 3 0 0 3

OBJECTIVES:
- To facilitate the students in knowing the application of statistical techniques in Quality control and assurance.

UNIT I INTRODUCTION

UNIT II CONTROL CHARTS
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES
Warning and modified control limits, control chart for individual measurements, multi-vari chart, X chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to
- Control the quality of processes using control charts for variables in manufacturing industries.
- Control the occurrence of defective product and the defects in manufacturing Companies.
- Control the occurrence of defects in services.

REFERENCES:
4. IS 2500 Standard sampling plans

OR7003 SCHEDULING ALGORITHMS L T P C 3 0 0 3

OBJECTIVES:
- To impart knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

UNIT I SCHEDULING THEORY

UNIT II SINGLE MACHINE SCHEDULING

UNIT III PARALLEL MACHINE SCHEDULING

UNIT IV FLOW SHOP SCHEDULING

UNIT V JOB SHOP SCHEDULING

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to
- Students will be able to design, analyse and implement single machine, parallel machine, flow shop, and job shop scheduling algorithms.
REFERENCES:

SO7003 DESIGN PATTERNS

OBJECTIVES:
- To understand the concept of patterns
- To learn various design patterns.
- To learn the usage of design patterns to keep code quality high.

UNIT I INTRODUCTION
History and Origin of Patterns – Introduction to OOAD – Apply Design Patterns – Prototype – Testing.

UNIT II DESIGN PATTERNS
Kinds of Pattern – Quality and Elements – Patterns and Rules – Creativity and Patterns – Creational Patterns – Structural Patterns – Behavioural Patterns, Factory Patterns.

UNIT III FRAMEWORKS
State and Strategy of Patterns. Singleton, Composite, Functions and the Command Patterns, Adaptor, Proxy Pattern, Decorator Pattern – Pattern Frameworks and Algorithms

UNIT IV CATALOGS
Pattern Catalogs and Writing Patterns, Anti-Patterns, Pattern Community, Pattern Based Software Development.

UNIT V CASE STUDIES
A7E - case study in utilizing architectural structures, WWW - case study in interoperability, Air Traffic Control – case study in designing for high availability, Celsius Tech – case study in product line development

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the course, the student will be able to
- Comprehend most important design patterns
- Apply design patterns to design innovative software.
- Familiarize real time applications developed with case studies.

REFERENCES:
OBJECTIVES:
- To learn about the concepts of java and it features.
- To learn about the concept of networking, API and GUI in java.
- To learn solve Operations Research problems using JAVA.

UNIT I  INTRODUCTION TO JAVA  9

UNIT II  NETWORKING, APPLETS and GUI  9
RMI and RMI-IIOP - Custom sockets - Object serialization - Retrieving Data with URLs - Sockets for clients - Sockets for servers - Secure Sockets - UDP datagrams and sockets - Multicast Sockets - Applets - Developing GUI Applications.

UNIT III  ENTERPRISE JAVA  9
Java Beans Enterprise - Java Beans - Distributed Object models - URL Connection class - Protocol Handlers - Content Handlers - Distributed garbage collection - Interface definition language.

UNIT IV  SOLVING OPERATIONS RESEARCH PROBLEMS  9
Solving Operations Research problems - Constraint programming problems - Linear programming problems - Integer programming problems

UNIT V  SOLUTION USING GRAPH AND KNAPSACK ALGORITHMS  9
Graph and Knapsack algorithms - Bin packing and knapsack algorithms - Traveling Salesman Problem - Vehicle Routing Problem - Graph algorithms - shortest paths - min cost flow - max flow - linear sum assignment.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Write programs using java
- Develop solution to operation research problems.

REFERENCES: