M. Sc. DEGREE

OPERATIONS RESEARCH AND COMPUTER APPLICATIONS

SYLLABUS
FOR
CREDIT BASED CURRICULUM

DEPARTMENT OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015, INDIA.
# SEMESTER I

<table>
<thead>
<tr>
<th>Code</th>
<th>Course of Study</th>
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<td>CA 761</td>
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## Electives

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Semester I

CA761 PROBABILITY, STATISTICS AND ESTIMATION

Pre-requisites: Calculus and Linear Algebra

Random experiments, Probability spaces, Elementary theorems, Conditional probabilities, Independent events.

Probabilistic modeling and random variables, cdf and pdf of random variables; standard discrete and continuous models.

MGF and Characteristic functions, multivariate distributions; transformations, Covariance and correlation, Random variable sequences, inequalities.

MMS, MLE and linear Estimation, multivariate normal distribution.

Sampling distribution; interval Estimation and Tests of hypotheses.

Books

CA763 DISCRETE MATHEMATICS

Sets - Relations - Posets - Functions - Mathematical Inductions (Simple and strong) - Propositional and Predicate Calculus - Proof by inference and truth tables.


Spanning trees, Euler and Hamiltonian graphs - directed graphs - Strong connectedness graphs - MST algorithms of Prim and Kruskal - Shortest path and Max-flow algorithms.

Groups, subgroups, normal subgroups, Vector spaces, Basis and Dimension, Linear codes, Error Correction, generating Matrix, Standard decoding table, perfect and quasi-perfect codes.


Books:
2. Narsingh Deo, "Graph theory and application to Engineering and computer Science", 1986, PHI
MA615 LINEAR PROGRAMMING AND SIMULATION


Duality - Primal and Dual LPP problems – Properties - Dual Simplex Method - Sensitivity analysis - Discrete changes in cost vector in requirement vector – Coefficient-matrix Parametric programming - Parameterization of cost vector and requirement vector.


Integer programming Problem - Gomory's method - Branch and bound. method. Linear Fractional programming – Variable transformation method - Updated objective function method - Bounded variable technique.


Books:

CA767 COMPUTER ORGANIZATION AND ARCHITECTURE

Objective : To introduce the nature and characteristics of modern day computers.

Pre- requisites: Knowledge of fundamentals of Digital Computers.

Number Systems - Binary Arithmetic - Boolean Algebra - Map Simplifications - Gates - Combinational Circuits - Sequential Circuits.

Memory - Internal Memory - External Memory - Memory Organization - Associative Memory - Cache Memory.

CPU - Arithmetic And Logic Unit - Instruction Sets - Addressing modes and formats - Instruction pipeline - Register organization - Control Unit Operation - Processor organization - Types of Processors.

External Devices - I/O modules - Programmed I/O - Interrupt Driven - Direct Memory Access - I/O Channels - Asynchronous Data Transfer.

Reduced Instruction Set Computers –Super Scalar Processors – Multiprocessing vector computation - Parallel Processors.
Books:

CA769 PROGRAMMING IN C AND C++


Arrays - Pointers – Operations on pointers - Multidimensional Arrays.

Structures and Unions – Functions - Command Line Arguments - Dynamic Memory Allocation - File Allocation - Preprocessor Directives.

Object Oriented Programming Concepts - Constructors and Destructors - Static Members and Function - Friend Functions - Inheritance - this pointer.

Polymorphism - Function Overloading - Operator Overloading - Virtual Functions - Templates.

Books

CA751 LINEAR PROGRAMMING USING LINDO AND C

Linear Programming and Transportation algorithms to be programmed in LINDO and C. Sensitivity Analysis using LINDO.

CA753 PROGRAMMING LABS IN C AND C++

Programs on basic C and C++ concepts.

Semester II

MA602 NON LINEAR PROGRAMMING


Multi-dimensional unconstrained optimization - Univariate Method - Neider and Meads Method, Conjugate Directions and Conjugate Gradient – Fletcher-Reeves Method – Davidson-Fletcher- Powell Method.
M. Sc. (Operations Research and Computer Applications)


Separable programming - Piecewise linear Approximation Method - Case studies in Non linear Programming.

Books:

CA764 DATA ANALYTICS

The course is application based. SPSS or SAS package will be used for applications and analysis part. The theory content is worth is 70 % and 30 % is for SPSS or SAS exercises.

Pre-requisites: CA 761


Discriminant Analysis-Two group problem, Variable contribution, Violation of assumptions, Discrete and Logistic Discrimination, The k-group problem, multiple groups, Interpretation of Multiple group Discriminant Analysis solutions.

Principal Component Analysis-Extracting Principal Components, Graphing of Principal Components, Some sampling Distribution results, Component scores, Large sample Inferences, Monitoring Quality with principal Components.

Factor Analysis-Orthogonal Factor Model, Communalities, Factor Solutions and rotation.

Books

CA766 OPERATING SYSTEMS

Pre-requisites: CA 767, CA 769


Memory Management: Paging, segmentation, Demand Paging, Page Replacement, Allocation of Frames.
M. Sc. (Operations Research and Computer Applications)


Books:

CA768 DATABASE MANAGEMENT SYSTEMS

Pre-requisites: CA 767, CA 770
Co-requisite: CA 766

Introduction to database systems - Database Administration - Database system architecture and data dictionary- Relational, Hierarchical, Network Models.

E-R models - Relational algebra - relational calculus and SQL.

Relational Database Design - Functional dependencies - Normal Forms.

Concurrency control- backup and recovery- integrity and security- Database performance-tuning and monitoring. Concepts on distributed database systems.

Current DBMS packages – SQL.

Books

CA770 DATA STRUCTURES AND ALGORITHMS

Pre-requisite: CA 763, CA 761, CA 769

Arrays, stacks, queues, linked lists, trees- their applications. Fundamental Strategies in algorithm design - recursion, divide and conquer, greedy and dynamic programming methods.


Graph algorithms- breadth and depth first searches, MST using disjoint set union algorithm, single source and all pairs shortest path, flow networks, maximum bipartite matching – complexity analysis.

Department of Computer Applications, National Institute of Technology, Tiruchirappalli – 620 015.
Polynomials - FFT, multiplication of large integers, Algorithms for random number generation. probabilistic algorithms- selection, sorting, searching and Monte Carlo methods.

Definition of non-deterministic polynomial algorithms. Basic concepts of NP-Hard and NP-complete problems- Cook's theorem, Reduction of Clique, Node cover, Chromatic Number as NPC. Scheduling problem - NP hard.

**Books**


**CA752 DATA STRUCTURES LAB**

Implementing the algorithms studied in CA 770.

**CA754 UNIX / LINUX LAB**

Problems on Shell Programming and concurrency.

**Semester III**

**MA617 REPLACEMENT, RELIABILITY AND NETWORK MODELS**

Single Commodity Static flows - the basic maximum flow problem - Variations of the maximum flow problem - Flows in graphs with gains – Multi-commodity flows.


Equipment replacement policies in deterministic and Stochastic cases - replacement models for unbounded horizons and uncertain cost-replacement in anticipation of failure -group replacement policy.


Simulation and Reliability Predictions - Maintenance- preventive and corrective – Maintainability Equation – Availability - Maintainability trade-off - Reliability improvement and allocation.

**Books:**

CA773 VISUAL PROGRAMMING


VB.NET – basic features - Inheritance, Value Types, Operator Overloading, Exception Handling, Arrays and Collections, Properties, Delegates and Events, Windows Forms, Dialog Boxes and Controls, Graphical Output, Files, Data access.

C#.NET – basic features, Arrays and Collections, parameter arrays, Inheritance, Garbage collection and Resource management.

ASP.NET – Validation controls – Accessing Data with web forms – Building ASP.NET applications – Building and XML web service handling XML.

Books:
1. Jeff Prosise, Programming Microsoft .NET, Microsoft Press

CA775 INVENTORY THEORY AND DYNAMIC PROGRAMMING

Objective: To learn how to control inventory costs and applications of Dynamic programming
Pre-requisite: Knowledge of Calculus

Inventory control - Different variables involved. Single item deterministic- Economic lot size models with uniform rate, finite & infinite production rates, with or without shortage-Multi-item models with one constant.

Deterministic models with price-breaks- All units discount model and incremental discount model. Probabilistic single period profit maximization models with uniform demand, instantaneous demand, with or without setup cost.

Dynamic inventory models, Multi-echelon problems. Integrated approach to production inventory and to maintenance problems. Feed back control in inventory management.


Applications of dynamic programming-The shortest path through a network, production planning, inventory problems, investment planning, cargo loading and Knapsack problems.
Books

Electives

CA781 ADVANCED DATA ANALYTICS

The course is application based. SPSS or SAS package will be used for applications and analysis part. The theory content is worth is 70% and 30% is for SPSS or SAS exercises.

Pre-requisites: CA 761, CA 764

Spatial map using metric and non-metric data, Naming and interpreting the dimensions using canonical correlation.

Attribute based perceptual map using factor analysis, Spatial map using preference data through simple Euclidean model.


Canonical Correlation Analysis-Canonical Variates, and Correlations.

Interpreting the Population Canonical Variates, Sample Canonical Variates and sample Canonical correlations, Large Sample Inferences; MANOVA.

Books:

CA782 MULTIPLE CRITERIA DECISION MAKING


Multiple Criteria Decision Making: Basic concepts, static and dynamic optimization, problem formulation, pareto optimality, efficient set, classification of methods.


Linear Goal Programming- deviation variables, Pre-emptive priorities, Graphical Method, Modified Simplex Method, Branch and Bound Method and Cutting Plane Method for integer
Goal programming models, Non-Linear Goal Programming- Simplex based Method- Pattern Search Method.


Real-time problems based on student background.

Books:

CA783 LOGISTICS MANAGEMENT

Logistics - Definition – concepts- activities - functions.

Transportation - warehousing, order processing, information handling and procurement. Materials management functions and control, inventory - Management in logistics system, inventory decision-making, MRP, MRP in systems, multi-echelons.

Distribution Management, Outbound logistics, Facility location, Classical location problems, Strategic planning models for location analysis, location models, multi objective analysis of location models, Overview Of Vehicle Routing Problems, Integrated Models Of Location And Routing, direct shipment, warehousing, cross-docking; push vs. pull systems.


Logistics in different industries: Third party, and fourth party logistics, Airline Schedule Planning, Railway Networks, Postal services, the maritime industries, health

Books

CA784 SUPPLY CHAIN MANAGEMENT

Fundamentals of Supply Chain Management, Supply chain networks, Integrated supply chain planning, Decision phases in s supply chain, Supply chain models and modeling systems.

Supply chain planning: Strategic, operational and tactical, Supply chain strategies, Supply chain drivers and obstacles, Strategic Alliances and Outsourcing, purchasing aspects of supply chain.
Supply chain performance measurement: The balanced score card approach, Performance Metrics. Planning demand and supply, Demand forecasting in supply chain, Aggregate planning in supply chain, Predictable variability. Supply Chain Inventory Management.

Inventory theory models: Economic Order Quantity Models, Reorder Point Models and Multi-echelon Inventory Systems, Relevant deterministic and stochastic inventory models and Vendor managed inventory models. Role of transportation in a supply chain: direct shipment, warehousing, cross-docking; push vs. pull systems; transportation decisions (mode selection, fleet size), market channel structure, vehicle routing problem. Decisions in a supply chain, Mathematical Foundations of distribution management, Supply chain facility layout and capacity planning.

Strategic Cost Management in Supply Chain. The financial impacts, Volume leveraging and cross docking, global logistics and material positioning, global supplier development, target pricing, cost management enablers, Measuring service levels in supply chains, Customer Satisfaction

Books

CA785 QUALITY CONTROL AND ASSURANCE

Pre-requisite: CA761


Control Charts for variables - control chart for X and R - Control chart for X and S - Control Charts for attributes - Control Charts for fraction defective- Control Chart for conformities-Control Chart for non - conformities.

Fundamentals of experimental design– factorial experiments for process design and improvement - fractional factorial experiments for process design and improvement. The Acceptance Sampling Problem- Single Sampling plans for attributes- double, multiple and sequential sampling- AOQL plans.


Books:
M. Sc. (Operations Research and Computer Applications)

CA786 DECISION SUPPORT SYSTEMS

**Pre-requisite:** Knowledge of computers and its general applications and basic understanding of managerial decision making in functional areas of management.

Decision making process- problem solving techniques- how decisions are being supported- decision styles- group decision making.

Features of various CBIS. DSS - characteristic and capabilities of DSS- components of DSS Classification of DSS.

Sources of data- data file environment – database environment – data models- relevance of relational Database design in DSS. Model Base Management Systems: Types of models- function, time, certainty, uncertainty, risk, structure- OR models- Dichotomous model of mind- Simon's model in information system design.

User interface: graphics, menus, forms, DSS tools- DSS generators- specific DSS, Constructing a DSS steps in designing a DSS- identification of decision, building of DBMS, MBMS and DGMS- implementation, performance, testing Case studies on DSS applications. Executive information needs- characteristics and capabilities of EIS- EIS model- EIS implementation Decision.

**Books**

CA787 SOFTWARE ENGINEERING

Introductory concepts – The evolving role of software – Its characteristics, components and applications- A layered technology – the software process.


**Books:**
CA788 OBJECT ORIENTED PROGRAMMING, ANALYSIS AND DESIGN

Pre-requisites: Programming in C and C++


Books

CA789 4GL AND 5GL SYSTEMS

Pre-requisites: Database Management Systems

4GL systems- Scope, Application and Method of Evaluation.

Program development with intelligent workstations- Distributed information services and Management - PC to mainframe links.

SQL dialects- Embedded SQL- QUEL- QBE Paradox QBE - Constraints. 4GL systems, Software development components and building blocks.


Database programming - Case Studies in 4GL and 5GL.

Books
2. Dimitris N Chorafas, "Fourth and Fifth generation Programming Languages", 1986, Addison Wesley
CA790 GRAPHICS AND MULTIMEDIA

**Pre-requisites:** Matrix Theory, Analytical Geometry, Trigonometry


Two dimensional transformations – Scan Conversion Algorithms – Windowing – Clipping – Segmenting – Viewport Transformations.


**Books**

CA791 COMPUTER NETWORKS

**Prerequisites:** Computer Organization and Architecture, Operating Systems


Transport-Layer Services - Multiplexing and Demultiplexing - Principles of Reliable Data Transfer - Congestion Control – TCP’s Congestion Control.


**Books**

CA755 VISUAL PROGRAMMING LAB

Exercises to learn programming in C#, ASP, VB - .NET languages (etc).

CA757 DBMS LAB

Exercises / case studies that require table design, normalization and query building.