MASTER OF SCIENCE
(Operations Research and Computer Applications)

SYLLABUS
FOR
CREDIT-BASED CURRICULUM
(Applicable for 2011-2012 batch onwards)

DEPARTMENT OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI 620 015
TAMILNADU, INDIA
Objective of the Programme:

This programme is structured to enable undergraduate students of any discipline to evolve as Masters in Science (Operations Research and Computer Applications). The programme imparts basic concepts of Operations Research, Computer Science and Applications. The programme also provides for development of comprehensive knowledge and skills to establish systems developed based on optimization techniques and to automate systems suitably for the emerging needs in the IT and IT enabled industries.

The total credits required for completing the M.C.A. programme is 65.

**SEMESTER I**

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<tr>
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### SEMESTER VI

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Grand Total 45 0 24 65

L : LECTURE | T : TUTORIAL | P : PRACTICAL | C : CREDITS
## ELECTIVES

*(All 3-0-0-3)*

<table>
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<tr>
<th>Subject Code</th>
<th>Course of study</th>
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<tr>
<td>CA 781</td>
<td>Advanced Data Analytics</td>
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<tr>
<td>CA 782</td>
<td>Multiple Criteria and Decision Making</td>
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<td>CA 783</td>
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<td>CA 784</td>
<td>Supply Chain Management</td>
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<td>Quality Control and Assurance</td>
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<td>CA 786</td>
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<td>Graphics and Multimedia</td>
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<td>CA 791</td>
<td>Computer Networks</td>
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Semester I

CA761

PROBABILITY, STATISTICS AND ESTIMATION

Pre-requisites: Calculus and Linear Algebra

Outline:


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

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

4. MMS, MLE and linear Estimation, multivariate normal distribution.

5. Sampling distribution; interval Estimation and Tests of hypotheses.

Books:


CA763

DISCRETE MATHEMATICS

Outline:

Sets - Relations – Posets - Functions - Mathematical Inductions (Simple and strong) – Principles of Counting (Addition & Multiplication)

Recurrence Relations and Generating Functions - Homogeneous and non-homogeneous recurrences and their solutions - solving recurrences using generating functions


Finite Automata – Context-Free Grammars – Chomsky’s Normal form -Griebach Normal Form - Push-down Automata - Equivalence of CFL’s and PDA’s - Non-context free languages.

REFERENCES

2. Narsingh Deo, “Graph theory and applications to Engineering and Computer Science”, 1986, PHI.

MA615

LINEAR PROGRAMMING AND SIMULATION

Outline:


2. 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.


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.

Outline:

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


CPU: Arithmetic And Logic Unit - Instruction Sets - RISC - CISC - Instruction pipeline - Addressing modes and formats - Register organization - Control Unit Operation - Processor organization.

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


REFERENCES
PROGRAMMING IN C AND C++

Outline:


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

Books:


LINEAR PROGRAMMING USING LINDO AND C

Linear Programming and Transportation algorithms to be programmed in LINDO and C. Sensitivity Analysis using LINDO.
PROGRAMMING LABS IN C AND C++

Programs on basic C and C++ concepts.

Semester II

MA602

NON-LINEAR PROGRAMMING

Outline:


Multi-dimensional unconstrained optimization - Univariate Method - Neider and Meads Method, Conjugate Directions and Conjugate Gradient – Fletcher-Reeves Method – Davidson-Fletcher-Powell Method.


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

Books:


**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

**Outline:**

General Linear Regression Model, Estimation for $\beta$, Error Estimation, Residual Analysis.

Tests of significance - ANOVA, ‘t’ test, Forward, Backward, Sequential, Stepwise, All possible subsets, Dummy Regression, Logistic Regression, Multi-collinearity.

 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:**


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**OPERATING SYSTEMS**

**Pre-requisites:** CA 767, CA 769
Outline:


Protection and security. Case Study-Linux Operating system-The Linux Kernel-Design principles-Scheduling-Memory management-Files system-Input and Output- Inter process communication-Security

REFERENCES


DATABASE MANAGEMENT SYSTEMS

Pre-requisites: CA 767, CA 770

Co-requisite: CA 766

Outline:


Relational Model – Constraints – Querying – Views - Relational Algebra and Relational Calculus - SQL & QBE.
Organization and Indexes - B⁺ Trees – Query Optimization.

Database Design - Functional Dependencies, Normalization – 1 to 5 Normal Forms.


REFERENCES


CA770

DATA STRUCTURES AND ALGORITHMS

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

Outline:

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.

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

Outline:

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

Outline:


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

Outline:

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:


CA755

VISUAL PROGRAMMING LAB

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

CA757
Exercises / case studies that require table design, normalization and query building.

**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 70% and 30% is for SPSS or SAS exercises.

**Pre-requisites:** CA 761, CA 764

**Outline:**

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**

Outline:

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

Outline:

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.

Transportation decisions (mode, selection, fleet size), market channel structure. Logistics Customer Service, Modelling logistics systems, Simulation of logistic systems, cost effective
distribution strategies, Value of information in logistics, E-logistics, risk-pooling effect, International and global issues in logistics, Integrated functional activities in logistics, Role of government in international logistics, Principal characteristics of logistics in various countries and regions.

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

Outline:

Fundamentals of Supply Chain Management, Supply chain networks, Integrated supply chain planning, Decision phases in 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

Outline:


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:


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.

Outline:
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

Outline:
Introductory concepts – The evolving role of software – Its characteristics, components and applications- A layered technology – the software process – Software process models - Software process and project metrics – Measures, Metrics and Indicators.


Testing fundamentals – Test case design – White box testing – Basis path testing – Control structure testing – Black box testing – Strategies: Unit testing integration testing – Validation Testing – System testing – Art of debugging.


REFERENCES


CA788 OBJECT ORIENTED PROGRAMMING, ANALYSIS AND DESIGN

Pre-requisites: Programming in C and C++

Outline:


Notation elements — Class, State Transition object, Interaction, module and process diagrams - OMT analysis (James & Rumbaugh) - Comparison of various OO Analysis of Design Methodologies.

OO Applications – Case Studies – UML – Diagrams with examples – Applications - Design Patterns - Pattern Categories - Relationships between patterns - Pattern descriptions – Patterns based Applicatios.

REFERENCES

5. E. Gamma, R. Helm, R. Johnson and J. Vlissides, “Design Patterns- Elements of Reusable Object-Oriented Software”, 1995, Addison-Wesley.

CA789 4GL AND 5GL SYSTEMS

Pre-requisites: Database Management Systems

Outline:

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

Outline:


REFERENCES


CA791 COMPUTER NETWORKS

Prerequisites: Computer Organization and Architecture, Operating Systems

Outline:


Reliable Byte Stream (TCP) – Simple Demultiplexer (UDP) – TCP Congestion Control – Congestion Avoidance Mechanisms.

Domain Name Service (DNS) – Email - SMTP – MIME – HTTP – SNMP-TELNET-FTP.


REFERENCES