MASTER OF 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 Computer Applications. The programme imparts basic concepts of Computer Science and Applications. The programme also provides for development of comprehensive knowledge and skills to automate systems suitably for the emerging needs in the IT and IT-enabled industries.

Faculty members of the Department

**Head**
Dr. S. Nickolas

**Professors**
Dr. N. P. Gopalan
Dr. A. V. Reddy
Dr. B. Ramadoss

**Associate Professors**
Dr. Michael Arock
Dr. A. Vadivel
Dr. S. R. Balasundaram
Dr. P. J. A. Alphonse

**Assistant Professors**
Dr. S. Domnic
Dr. B. Janet
Mrs. S. Sangeeta
Ms. R. Eswari
Mr. U. Srinivasulu Reddy
M.C.A. Programme

The total credits required for completing the M.C.A. programme is 103.

SEMESTER I

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SEMESTER II

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Grand Total 75 25 40 103
### ELECTIVES

(All 3-0-0-3)

#### List A

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<td>CA735</td>
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<tr>
<td>CA 751</td>
<td>Business Intelligence</td>
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CA 711 PROBLEM SOLVING AND PROGRAMMING

Objective: To learn problem solving methodologies and aspects of C.


C Language Fundamentals: Character set – Various constants – Keywords – Primitive data types – Declaration - Syntax for Sequential, selective and repetitive structures – Sample codes for each.

Arrays – Declaration, accessing array elements and initialization- Passing array elements and arrays as arguments - Functions – Definition, call, prototypes, block structure, external variables

Storage Classes – extern declaration and information hiding.

Pointers – Address and indirection operators, Pointer type declaration, assignment, initialization – Pointer arithmetic – Functions and pointers – Arrays and pointers – Strings and pointers – Multi-dimensional arrays and pointers – Pointer arrays – Pointers to functions – Dynamic memory management.


REFERENCES

CA 713 MATHEMATICAL FOUNDATIONS OF COMPUTER APPLICATIONS

Objective: To learn the relevant mathematical ideas applicable to computers.

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.

CA 715 COMPUTER ORGANIZATION AND ARCHITECTURE

Pre-requisite: Knowledge of fundamentals of Digital Computers

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

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


CA 717 ACCOUNTING AND FINANCIAL MANAGEMENT

Objective: To learn the fundamentals of accounting and financial management.


Depreciation – Methods - Inventory methods, Sources of working capital, Fund flows, Cash flows – Financial Statement analysis.


Variable costs – Fixed costs – Cost Volume Profit Analysis – Break even marginal and full costing contribution, Standard costing - Analysis of variance computer accounting and algorithms.

Characteristics of Budgets - Forecasting – Long term, Short term – Methods of capital investment decision making, Sensitivity Analysis, Cost of capital.

REFERENCES

CA 719 BUSINESS PROCESSES

Objective: To make aware of various business processes and to learn the nuances in them.


Organizational Power and Power Outcomes-Leadership and Decision Making-Communication and Organizational Change-Organizational Environments and Effects-Inter and Intra organizational Relationships-Organizational Effectiveness-Case Studies.


BPR and Information Technology Process-People View and Perspectives-Empowering People through IT-Managing Change in the Global Environment-BPR Rediscovering Indian Paradigm-Need of Reengineering-Case Studies.


REFERENCES


CA701 PROGRAMMING LAB

Exercises for learning basic principles of structured programming with features of C language.
CA703 BUSINESS COMMUNICATION

Objective: To enable and practice modern communication skills.

Communication: concepts and Goals – Theories of communication – Organizational and personal goals.

Psychology of communication – Channels and Networks – Barriers to and cost of communication – Message Planning – Purposive Listening – types – Familiarity to different accents and tones.


Business Correspondence – Different kinds of written communication in business organizations.


REFERENCES


CA 710 DATA STRUCTURES

Objective: To introduce different data structures; searching and sorting techniques and their applications.


Binary Trees – Binary Tree Representations – node representation, internal and external nodes, implicit array representation - Operations on binary trees – Binary tree Traversals - Representing Lists as Binary Trees.


REFERENCES


CA712 DATABASE MANAGEMENT SYSTEMS

Pre-requisites: Programming Languages – File Concepts

Objective: To learn different database models and design of databases; query languages and transaction management.


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

CA 714 COMPUTER NETWORKS

Objectives: To know about different network architectures and to learn routing protocols, to understand the concepts of data communications, to study the functions of different layers, to introduce IEEE standards employed in computer networking and to make the students to get familiarized with different protocols and network components.


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


CA716 OBJECT-ORIENTED PROGRAMMING

Objective: To learn the basic principles of object-oriented programming paradigm.

Pre-Requisite: A Procedure-oriented Programming Language

Arrays – Pointers – this pointer – References – Dynamic memory Allocation – functions
Overloading – Default arguments – Overloading Constructors – Pointers to Functions –
Ambiguity in function overloading - Operator Overloading – Members Operator Function –
Unary and Binary Overloading - Friend Operator Function – Overloading some special operators
like [ ], ( ), a and comma operator - Binary Operators - Data Conversion - Pitfalls of Operators
Overloading And Conversion - Keywords Explicit And Mutable.

Issues in Inheritance - Protected members – Virtual base Class – Polymorphism – Virtual
functions – Pure virtual functions – Applications.

Class templates and generic classes – Function templates and generic functions – Overloading
function templates – power of templates – Exception Handling – Derived class Exception – over
handling generic functions – Exception handling Functions – terminate () unexpected () –
Uncaught – exception ().

Streams – Formatted I/O with IOS class functions and manipulators – creating own manipulator
– overloading << and >> - File I/O – Name spaces – conversion functions – Array based I/O –
Overloading << & >> operators, Error handling during file operations, Formatted I/O - STL-
Overview-Container Classes Lists-Maps- Algorithms Using Functions and Objects-String Class -
Sequence Containers, Iterators, Specialized Iterators, Associative Containers, Storing User-
Defined Object, Function Objects.

REFERENCES

2. J.P. Cohoon and J.W. Davidson, “C++ Program Design – An Introduction to Programming
   Education, New Delhi.
   Singapore.

CA 718 RESOURCE MANAGEMENT TECHNIQUES

Objective: To learn different resource management techniques.

One dimensional unconstrained optimization – Fibonacci method – Golden section method –
Quadratic approximation method – constrained optimization with Lagrangian multipliers –
simple problems.


Functions of inventories – Deterministic Inventory problems with or without shortage cost – Multi-item deterministic inventory problem – Inventory problem with price breaks – probabilistic models with uniform demand (discrete and continuous cases).

Queuing theory - notation and assumptions – characteristics of queue – Poisson input process – exponential service times – Queuing models – M/M/1 – M/M/C – M/M/1/N – M/M/C/N – Simple problems.

REFERENCES


CA702 DBMS LAB

Pre -requisite: CA 712

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

CA704 DATA STRUCTURES LAB

Pre -requisite: CA 711

Exercises to implement various data structures.

CA721 DATA WAREHOUSING AND DATA MINING

Pre-requisites: CA 719, CA 712, CA 714

Objective: To introduce concepts of data warehousing and data mining techniques.

Introduction - motivation, importance, Functionalities, Basic DM Vs KDD, DM Metrics, DM Applications.
Data Warehousing: Difference between Operational Database and Data warehouse - Multidimensional Data Model - DW Architecture Efficient Processing of OLAP queries, Metadata repository.

Data Preprocessing: Data cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept Hierarchy Generation.

Data Mining Query Language- Association Rule Mining - Classification and Prediction - Cluster Analysis - Outlier Analysis.

Web content Mining, Web Structure Mining, Web usage Mining, Spatial Mining - Temporal Mining.

REFERENCES

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 2001, Harcourt India Private Limited.

CA 723 GRAPHICS AND MULTIMEDIA

Pre-requisites: Matrix Theory, Analytical Geometry, Trigonometry

Objectives: To learn different algorithms and transforms related to graphics; to introduce concepts of multimedia.


REFERENCES


CA 725 SOFTWARE ENGINEERING

Objective: To introduce the methodologies involved in the development and maintenance of software throughout its life cycle.

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.

Risk Management: Reactive vs. Proactive Risk Strategies – Software Risks – Risk Identification


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

CA 727 OPERATING SYSTEMS

**Pre-requisites:** Computer Organization and Architecture and Data Structures

**Objective:** To introduce basic concepts of OS; features of OS with case studies.


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

**REFERENCES**


CA729 OBJECT-ORIENTED ANALYSIS AND DESIGN

**Pre – requisites:** Procedure Oriented System Development

**Objectives:** To introduce and describe the object-oriented software development process, including object-oriented methodologies and workflows, tTo make students to analyze system requirements to determine the use cases and domain model of the problem domain and to design real-world applications using OO principles.

Object Model – Evolution, Elements – Nature of Classes and Objects – Relationships among
Classes - Classification – Identification of classes and objects – Key abstractions and mechanisms – Basic and Advanced Modeling techniques.


Object Oriented Database - Relational Database Design – Mapping Object Models to tables - OODB Features - OO Data Model, Complex Object, Persistence, Transaction, Concurrency Control, OODB Architecture, Query Language for OO Relational Databases, Gemstone / O2 / Orion

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

CA705 OS AND NETWORKS LAB

Pre-requisites: CA 716

Exercises to learn various commands in prevailing operating systems and implement scheduling and the like algorithms; to learn networking principles.

CA707 CASE TOOLS LAB

Pre-requisites: CA 729

Exercises to learn tools for – System Analysis, Design (DFD, ERD, Class Diagrams etc.) – Testing – Configuration Management – Project Management
CA720  INTERNET AND JAVA PROGRAMMING

Pre-requisite: CA 729

Objectives: To introduce the concepts, techniques, protocols related to internet technology, to deal with various services and supporting tools for internet applications, to introduce various concepts of Java for developing general purpose, object oriented, network enabled and multithreaded applications, and to build client-server and distributed applications using Java.

Introduction – History of Internet and Evolution (LAN, WAN, etc.) – Basics of Communications-Accessing the Internet – Connection Services – Internet Resources – Internet Addressing – Elements associated with internet - hardware, media, etc. - Internet Protocols – ICMP, IGMP, UDP, TCP/IP, HTTP – other protocols – Gopher, WAIS applications – Mail and its types – Remote access and Transactions.

Services, Searchers, Browsers: Directory Services, Finger, WAIS, Whois, DNS, Net Find, X500 – DHCP, X500 Directory Services, LDAP, Internet Security- Browsing and Searching – Web indexes – Search Engines and their types with design (e.g. Google, Yahoo, etc.).


Internetworking Architectures and Applications - Examples in Servlets and RMI - Database Handling – Mobile and Wireless Applications.

REFERENCES

CA722 INFORMATION SECURITY

Objective: To study the critical need for ensuring Information Security in Organizations


REFERENCES


CA724 SOFTWARE ARCHITECTURE AND SOFTWARE PROJECT MANAGEMENT

Objective: To introduce software architecture aspects for designing complex softwares and learn CMM models and project management techniques.


Design Patterns - Evolution patterns - Software artifact evolution processes - Case studies - Java Beans.


REFERENCES


CA 726 DESIGN AND ANALYSIS OF ALGORITHMS

Objective: To introduce complexity finding methods and various algorithmic design methodologies.


REFERENCES


CA706  JAVA PROGRAMMING LAB

Pre-requisite: CA 720

Exercises / case studies that require object-oriented, Internet and GUI based applications in JAVA.

CA708  INFORMATION SECURITY LAB

Exercises to learn information security related programming.

CA731  WEB TECHNOLOGY

Pre-requisites: CA 729, CA 720

Objectives: To introduce the basic elements and activities of World Wide Web Consortium, to design effective web applications including portals, e-commerce sites etc., to introduce features of mark up languages such as HTML, XML etc., to build applications using scripting – client side as well as server side and to introduce the powerful components of web technologies such as PHP, AJAX etc.

W3C Activities – Web Essentials - Markup Languages – HTML - List, Table, Frame, Form Tags with their usage – Creation and Design of Static and Dynamic Web Pages – Web Design characteristics.


REFERENCES


CA 733 DISTRIBUTED SYSTEMS

Pre-requisites: Operating Systems, Data Communication, Java or C++ programming language.

Objectives: To understand the concept of distributed systems, to get the knowledge of distributed file systems and web based systems and to understand the issues involved in the design of distributed systems.

Distributed Systems - Goals, Types, Challenges, Architectural models, Inter-process communication – client server communication, group communication, RPC, RMI, Message oriented communication, Stream oriented communication.

Processes - Threads, Virtualization in Distributed Systems, Clients, Servers, Code Migration, Software agents, Naming, Synchronization in distributed systems, Distributed mutual exclusion.


Distributed document-based systems – World Wide Web, Lotus notes, Distributed Coordination based systems – Introduction, TIB / RENDEZVOUS, JINI.
REFERENCES


CA709  WEB TECHNOLOGY LAB

Pre-requisite: CA 731

Exercises / case studies on HTML, XML, PHP, JSP etc. – Designing web portals.

CA 753 VISUAL PROGRAMMING LAB

Exercises to learn programming in VB/C#, ASP.NET language

CA736  UNIX INTERNALS

Objectives: To get the knowledge of kernel, to understand the file organization and memory management and to have the knowledge of process architecture and its communication methods.

UNIX  Operating System – History and goals – BSD, system structure, user perspective, OS services, Hardware, Kernel – Architecture, System concepts, Buffer cache – Headers, Buffer pool, Reading and Writing scenarios.

File Systems – Inodes, Directories, Conversion of a path name to an Inode, Super block, Inode assignment, Allocation of Disk blocks, Other file types, System calls for the file system.

Memory Management – Policies – Swapping, Demand paging, Hybrid System, Kernel Memory Management, I/O System – I/O mapping from User to Device, Driver Interfaces, Disk Drivers, Terminal Drivers, Streams.


REFERENCES


CA 735 SOFT COMPUTING

Objectives: To introduce the techniques of soft computing and hybridization of soft computing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.


Neural Network (NN), Biological foundation of Neural Network, Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back-propagation, Associative Learning, Competitive Networks, Hopfield Network, Computing with Neural Nets and applications of Neural Network.

Genetic Algorithms (GA) and evolutionary computing, Biological foundation of Genetic Algorithms, General steps in GA, Genetic Operations: cloning, crossover and mutation, Encoding and Selection techniques, Mathematical foundation and Schemata, Holland Schemata theorem, design and implementation of GA, issues in implementation of GA, applications of GA, Classifier systems, Genetic programming, new trends in GA.

Swarm Intelligence (SI), Biological foundation of SI, SI Techniques: Ant Colony Optimization (ACO) and Particle Swarm optimization (PSO), General steps in ACO, the "Invisible Manager" (Stigmergy), the Pheromone, Ant Colonies and Optimization, Ant Colonies and Clustering,
Applications of Ant Colony Optimization. PSO: Social Network Structure: The Neighborhood Principle, PSO Algorithm, Fitness Calculation, Convergence, PSO System Parameters, Particle Swarm Optimization versus Evolutionary Computing and Applications of PSO.


REFERENCES

CA737 .NET PROGRAMMING

Pre-requisites: A programming language, CA 712, CA 716, CA 729.

Objectives: To understand the principles of graphical user interface design, to enable a student to develop business applications using .NET and to develop web site and web service using ASP.NET.


REFERENCES


CA738 MULTI-CORE PROGRAMMING

Objective: To learn different multi-core programming techniques.

Multi-core – Definition and hybrid architectures – The software developer’s viewpoint – the bus connection – from single core to multi-core – Four effective multi-core designs.

Challenges of multi-core programming – Sequential model – definition – Concurrency – Definition – challenges pertaining to software development – Processor architecture challenges – Operating system’s role.


Communication and synchronization – synchronizing concurrency – Thread strategy approaches – Decomposition and encapsulation of work- Approaches to application design – PADL and PBS.


REFERENCES


**CA739 BUSINESS ETHICS**

**Objective:** To introduce business ethics and its practices.


Environmental Pollution and Society - Marketing Ethics (in Products, Pricing, Promotion and Place) and Consumer protection – Ethics in Human Resources management (Recruitment and promotion policies, Working Conditions, Down Sizing Workforce), Ethical issues at the top management, Ethics in financial markets and investor protection – Ethical responsibility towards competitors and business partners.

A Historical Perspective from Industrial Revolution to Social Activism – Current CSR practices of the firms in India and abroad. Conflicts in decision making from ethical and economic point of view - Ethical Dilemma - Solving ethical dilemma -Managerial integrity and decision making.

Personal Integrity and self development – wisdom based leadership.

History of Corporate form and models - Corporate Objectives and goals, Ownership pattern – Issues in managing public limited firms – Agency problems.

**REFERENCES**


**CA740 ORGANIZATIONAL BEHAVIOR AND PERSONNEL MANAGEMENT**

**Objective:** To learn fundamental principles of organizational behavior.


Personnel Function: Evaluation, objectives, principles, philosophies and policies, duties and responsibilities of the manager, position of the personnel department in the organization, line and staff relationship.

Manpower planning: Uses benefits problems and limitations, manpower, inventory, manpower forecasting, job description, recruitment, job specification and job selection interviewing techniques, transfers, promotion and its policies.

REFERENCES


CA741 IMAGE PROCESSING

Objective: To learn different fundamentals of image processing.


REFERENCES


CA742 NETWORK PROGRAMMING AND SECURITY

Objectives: To learn the basics of socket programming and network security issues and algorithms.


Applications, Theory: Euclidean algorithm, Euler Theorem, Fermat Theorem, Totent functions, multiplicative and additive inverse- RSA, Selection of public and private keys- Authentication-Security Handshake pitfalls, Online vs. offline password guessing, Reflection attacks, Perssion keys and authentication tickets, Key distribution centers and certificate authorities-Trusted Intermediaries- Public Key infrastructures, Certification authorities and key distribution centers, Kerberos.

REFERENCES


CA743 SOFTWARE AGENTS

Pre-requisites: CA 714, CA 719

Objective: To introduce concepts and types of software agents and their applications.


REFERENCES


CA744 MARKETING MANAGEMENT

Objective: To introduce concepts of marketing management.

Needs, wants and demands, product, value, satisfaction, marketing and markets - Evolution of marketing.


Product: Classification, mix decisions and line decisions, branding decisions and packaging - Channel: Nature, function, dynamics, design and management decisions.


Marketing control: Annual plan control, Profitability control, Efficiency control and strategies control. Marketing strategies: for leaders, followers, challengers, niche players and global markets.

REFERENCES


CA745 BIOINFORMATICS

Objectives: To make students understand Genomic data acquisition and analysis, comparative and predictive analysis of DNA and protein sequence, Phylogenetic inference etc.

Introduction to bioinformatics, classification of biological databases, Biological data formats, application of bioinformatics in various fields. Introduction to single letter code of amino acids, symbols used in nucleotides, data retrieval – Entrez and SRS.
Introduction to Sequence alignment, Substitution matrices, Scoring matrices – PAM and BLOSUM. Local and Global alignment concepts, dot plot, dynamic programming methodology, Multiple sequence alignment – Progressive alignment. Database searches for homologous sequences – FASTA AND BLAST versions.

Evolutionary analysis: distances - clustering methods – rooted and unrooted tree representation – Bootstrapping strategies.

Fragment assembly-Genome sequence assembly - Gene finding method, Gene prediction - Analysis and prediction of regulatory regions.


REFERENCES


CA 746 MOBILE AND PERVERSIVE COMPUTING

Objective: To introduce concepts of mobile computing and to learn concepts of pervasive computing and protocols.


REFERENCES

For UNIT I and II

For Unit III, IV and V
Prerequisites: Probability Distributions, Any Programming Language.

Objective: To learn different simulation models.

Simulation and Simulation Software - Systems – Models – Types, Components, Steps in Modeling –Simulation of statistical queuing, manufacturing and material handling.


REFERENCES

CA748  GRID AND CLOUD COMPUTING

Pre-requisite: CA 726

Objective: To introduce concepts of grid and cloud computing.


Cloud Service Models: Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS) – Case Studies.

REFERENCES


CA749  HUMAN COMPUTER INTERACTION

Objective: To learn various concepts of human computer interaction.

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design - A brief history of Screen design.
The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics-Principles of user interface.

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, and understanding business junctions.


REFERENCES

CA750 PORTFOLIO MANAGEMENT

Objective: To impart the basic principles of equity analysis and portfolio management.

Investment - Meaning and process of Investment Management – Speculation Investment Avenues in India.


Security Valuation – Bond, Equity and preference share valuation – Yield to maturity- Bond value theorems.

Portfolio Selection, performance evaluation and portfolio revision- Formula plans – Capital Asset Pricing Model (CAPM)

REFERENCES


CA 751 BUSINESS INTELLIGENCE

Decision Support and Business intelligence - Changing Business environments and computerized decision support, managerial decision making and support for decision making - DSS concept and framework Business intelligence - Major tools and techniques of managerial decision support - BI architectures.

Essentials of Business Intelligence-Origins and drivers of business intelligence, successful BI implementation, characteristics of BI-Architecting the Data, Enterprise Data Model and its Benefits, Granularity of Data in Data Warehouse and Role of Metadata.

Advanced Data Warehousing principles- Data warehousing architectures, DW development, real time DW and DW Administration and security issues-Visualization of Dimension model-Star, snowflake and other advanced models-Aggregated Fact tables -Relational DBMS Support for Dimensional Modeling- Advanced Topics in Dimensional Modeling - Selecting a Modeling Tool - Populating Data Warehouse.

Dimensional modeling in BI environment - Dimensional Modeling - Modeling considerations - Dimensional model design life cycle - Case studies - Business Analytics and data Visualization - Business analytics overview, reports and queries, Advanced business analytics , data visualization, Real time BI, Business analytics and web intelligence - Structure of mathematical models for decision support and visual interactive simulation.

Business performance Management - Business Intelligence Applications: Marketing models, Logistic and production models and Data Development analysis.

REFERENCES