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ಫ್ಯಾಕ್ಸ್: 0821-2419363 2419301

e-mail registrar@uni-mysore.ac.in
www.uni-mysore.ac.in

ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

ಸ್ಥಾಪನೆ : 1916

ವಿಶ್ವವಿದ್ಯಾನಿಲಯ ಕಾರ್ಯಸೌಧ,
ಕ್ರಾಫರ್ಡ್ ಭವನ, ಮೈಸೂರು-570005

ಸಂಖ್ಯೆ: ಎಸಿ2(ಎಸ್)/384/2014-15

ದಿನಾಂಕ: 27.07.2020

ಅಧಿಸೂಚನೆ

ವಿಷಯ: MCA ಕೋರ್ಸಿನ ಅವಧಿಯನ್ನು 03 ವರ್ಷಗಳಿಂದ 02 ವರ್ಷಗಳಿಗೆ ಕಡಿತಗೊಳಿಸಿರುವ ಸಂಬಂಧ ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿರುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: 1. ಅಧ್ಯಕ್ಷರು, ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ಮಂಡಳಿ, ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು ಇವರ ಪತ್ರ ದಿನಾಂಕ: 17.06.2020.
2. ದಿನಾಂಕ: 18.06.2020 ರಂದು ನಡೆದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ತೀರ್ಮಾನ.

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AICTE ಶಿಫಾರಸಿನ್ವಯ ಉಲ್ಲೇಖ (1)ರ ಪತ್ರದಲ್ಲಿ 03 ವರ್ಷಗಳ MCA ಕೋರ್ಸಿನ ಅವಧಿಯನ್ನು 2020-21 ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ 02 ವರ್ಷಗಳಿಗೆ ಕಡಿತಗೊಳಿಸಿದ ಸಂಬಂಧ, ಪಠ್ಯಕ್ರಮವನ್ನು ಸಿದ್ಧಪಡಿಸುವಂತೆ ಕೋರಿದ್ದರ ಹಿನ್ನಲೆಯಲ್ಲಿ, ಉಲ್ಲೇಖ (2)ರನ್ವಯ ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ಮಂಡಳಿಯು ಸಿದ್ಧಪಡಿಸಿದ ಪಠ್ಯಕ್ರಮವನ್ನು ನಿಕಾಯದ ಡೀನರು ಶಿಫಾರಸ್ಸು ಮಾಡಿರುವುದನ್ನು ದಿನಾಂಕ 18.06.2020ರಂದು ನಡೆದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯು ಅನುಮೋದಿಸಿರುತ್ತದೆ.

ಪ್ರಸ್ತುತ ಪರಿಷ್ಕೃತಗೊಂಡಿರುವ 2 ವರ್ಷಗಳ ಎಂ.ಸಿ.ಎ. ಕೋರ್ಸಿನ ಪಠ್ಯಕ್ರಮ ಹಾಗೂ ಪ್ರವೇಶಾತಿ ಅರ್ಹತೆ (Eligibility Criteria) ವನ್ನು ವಿಶ್ವವಿದ್ಯಾನಿಲಯದ ವೆಬ್‌ಸೈಟ್ www.uni-mysore.ac.inನಲ್ಲಿ ಪ್ರಕಟಿಸಲಾಗಿದೆ.

ಕುಲಸಚಿವರಿಂದ ಕರಡು ಅನುಮೋದಿಸಿದೆ

27/7

ಉಪ ಕುಲಸಚಿವ(ಶೈಕ್ಷಣಿಕ)
ಉಪಕುಲಸಚಿವರು (ಶೈಕ್ಷಣಿಕ)
ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ಮೈಸೂರು-570 005

ಗೆ:

1. ಡೀನರು, ವಿಜ್ಞಾನ ಹಾಗೂ ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯ, ಮನಃಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು.
2. ಅಧ್ಯಕ್ಷರು, ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ಮಂಡಳಿ, ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು.
3. ಅಧ್ಯಕ್ಷರು, ಗಣಕ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು.
4. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ ಮಂಡಳಿ, ಮೌಲ್ಯ ಭವನ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು.
5. ಉಪ ಕುಲಸಚಿವರು / ಸಹಾಯಕ ಕುಲಸಚಿವರು / ಅಧೀಕ್ಷಕರು, ಆಡಳಿತ ಶಾಖೆ ಹಾಗೂ ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು.
6. ಮಾನ್ಯ ಕುಲಪತಿ/ಕುಲಸಚಿವ/ಕುಲಸಚಿವ(ಪರೀಕ್ಷಾಂಗ)ರವರ ಆಪ್ತ ಸಹಾಯಕರು, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು.
7. ಕಛೇರಿ ಪ್ರತಿ.

UNIVERSITY OF MYSORE

Department of Studies Computer Science

PG Course Pattern and Scheme of Examination under CBCS (Model-2)

Programme: Master of Computer Application (MCA)

Programme Outcome:

After successful completion of MCA degree, the graduates will be able to:

- Apply the knowledge of Computer Science, Mathematics, Statistics and computing fundamentals to design and develop applications to provide creative solutions to various real life applications.
- Integrate and apply efficiently the contemporary IT tools and design applications with appropriate considerations for any specific need on societal and environmental aspects.
- Involve in perennial learning for a continued career development and progress as a computer professional upholding the ethics, social, cultural and cyber regulations.
- Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills and also to effectively present technical information in oral and written reports.
- Apply the inherent skills with absolute focus to function as a successful entrepreneur.

Programme Specific Outcome (PSO)

- Understand the concepts and applications in the field of Computing Sciences like Web designing and development, Mobile application development, and Network and communication technologies.
- Apply the learning from the courses and develop applications for real world problems.
- Understand the technological developments in the usage of modern design and development tools to analyze and design for a variety of applications.
- Communicate in both oral and written forms, demonstrating the practice of professional ethics and the concerns for social welfare.

Programme Pedagogy:

The various courses offered in the M.C.A. programme will have three major components such as Theory, Tutorial and Practical. Many courses have all the three components, some courses have only theory and tutorial/practical components and some courses have only theory components. So the nature of the course can be generally expressed as L:T:P model where L stands for lecture/theory, T stands for tutorial and P stands for practical.

The pedagogy to teach a particular course depends on the L:T:P model. In order to give a brief description about the pedagogy followed to teach a particular course, the courses with a particular L:T:P structure are grouped and the pedagogy followed to deliver the contents of the course is mentioned below:

For the courses that have theory and tutorial components (3:1:0), the theoretical concepts, principles and methods are explained with example analogy or use cases. Illustrative examples, theorem proving approaches, axioms, derivations, computing models and architectural descriptions are used to effectively demonstrate the ideas and to convey the philosophy of the course. Conventional black boards/white boards are used for writing and explanation. Smart boards, ICT tools such as power point, spreadsheet, word processing, database management and graphics are used for illustrations and descriptions of the concept. Animations, video clips and graphical illustrations are used whenever necessary to enhance the understanding of the concept. Group discussions, seminars and online demonstrations using specific tools are carried out to better understand the concepts.

For the courses that have theory and practical components (3:0:1), the theoretical concepts are taught as described in the previous paragraphs using conventional black/white board approach as well as smart ICT based approach. In addition, hands on experience will be provided through practical classes, where the students are allowed to use the computer and the related software tools to solve a particular problem, to provide a particular service as appropriate. With practical classes, students are exposed to current technology and gain an understanding how to solve a real time problem. A list of course specific assignments is used to practice and also to test the practical skills of the students.

For the courses that have all the three components i.e. Theory, Tutorial and Practical components, a blended mode of teaching, which includes conventional classroom teaching using black/white boards, smart classroom teaching using ICT tools, demonstrations through experiments and simulations followed by hands on experience with practical classes.

For the dissertation course, any real time/live projects will be selected and based on the nature of the project, field works for data collection, bridge courses for learning tools and technology needed to implement the solution to the problem undertaken are carried out. Further, internships at starts up companies/industries for more hands on experience with a particular platform will be encouraged.

Detailed Syllabi

Bridge Course: Foundations of Information Technology (2:1:1)

Course Outcome

- To introduce the fundamental concepts of computers and computing environment.
- To acquire the basic knowledge of algorithm design and problem solving using computers.
- To understand the concept of database management system and its importance.

Course Content

UNIT - I

Digital computers and Digital system: Number systems, Number base conversion, Complements, Binary codes, Binary arithmetic's. Boolean algebra: definitions, Basic theorems and properties of Boolean algebra, Venn diagram. Fundamentals of Computers. Introduction to Operating System.

UNIT - II

Problem solving techniques: Introduction, Problem solving procedure. Algorithm: Steps involved in algorithm development, Algorithms for simple problems, Flowcharts, Psuedocode. Introduction to C: Overview of C Program, Basic structure of a C - program. Constants, Variables & Data types: Character set, C token, Keywords & identifiers. Control Statements, functions, structures and unions.

UNIT - III

Data Structure: Types of Data structures, Arrays, Queues, Linked list, Trees, Searching and Sorting Algorithm: Searching – Introduction, Linear search, Binary Search, Sorting - Introduction, bubble sort, Insertion sort, Selection sort, Merge sort. Comparisons of searching and sorting techniques.

UNIT - IV

Database System concepts and architecture: Data Models, Schemas, and Instances, Three-schema architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Classification of Database Management Systems. Relational Data Model: Relational Model Concepts, Relational model Constraints and Relational Database Schemas, Update Operations, transactions and Dealing with Constraint Violations. SQL :Data manipulation in DBMS, Data types, SQL commands: Create Table, Inserting data, SELECT, DELETE, UPDATE, ALTER TABLE, DROP TABLE, RENAME, DESCRIBE

Reference Books

1. E. Balagurusamy, Programming in ANSI C, 7th Edition, Tata McGraw Hill.
2. Introduction to Information Technology ITL education solution Ltd, Second Edition
3. K.R. Venugopal and Sudeep R Prasad, Programming with C, 4th Edition, Tata McGraw-Hill Education.
4. Yashavant P. Kanetkar, Let Us C, 10th Edition, Tata McGraw Hill, 2010.
5. M.Morris Mano, Digital Logic and Computer design, PHI, 2015
6. Thomas L Floyd, Digital Fundamentals, 10th Edition, Pearson, 2011.
7. Thomas. C. Bartee, Digital Computer Fundamentals, 6th edition, TMH.
8. RamezElmasri and ShamkanthB.Navate, Fundamentals of Database Systems, 7th Edition, Pearson Education 2.
9. Ivan Bayross, SQL/PL/SQL- the Programming language of Oracle, 2nd Revised edition (or 4th revised Ed), BPB Publications.
10. Seymour Lipschutz, Data Structures with C, Schaum's Outlines Series, Tata McGraw Hill, 2011.
11. Horowtz Shani and etc et. Fundamentals of Data Structures in C, Universities Press, 2nd edition, 2008.
12. R. Venkatesan and S. Lovelyn Rose, Data Structures, First Edition:2015 , Wiley India Pvt. Ltd. Publications.

Bridge Course: Accountancy and Financial Management (2:1:1)

Course Outcome:

- Understand the basics of accountancy and financial management.
- Able to prepare trading accounts, balance sheet, profit and loss account.
- Able to perform ratio analysis and fund flow management.
- Acquire the knowledge about budgetary control, standard costing, marginal costing, capital budgeting.

Course Content:

Unit-1:

Fundamentals of accounting: Meaning of the book keeping, Objectives and Benefits, Accounting concept and conventions, journal, ledger, trial balance, and subsidiary books.

Sole trading accounts: Preparation of trading accounts, profit and loss account and balance sheet, problems on balance sheets.

Unit-2:

Ratio analysis: Meaning uses, kinds of ratios a) Liquidity ratios b) profitability ratios c) turnover ratios Simple problems on ratio analysis.

Fund Flow statement: Meaning uses, limitations, preparation of Statement of changes in working capital Statement of fund flow operations Fund flow statement.

Costing: Nature and importance of cost clarification and preparation of cost sheet.

Unit-3:

Budget and Budgetary control: Meaning of budget and budgeting, importance, limitations of budgetary control, Types of budget: Master budget and functional budget.

Standard Costing: Meaning of standard cost and standard costing uses, merits and demerits of, standard costing variance analysis, problems on material cost variance, material price variance, material usage (quantity) variance, material mix and yield variances.

Unit-4:

Marginal Costing:

Meaning of marginal cost and marginal costing, basic concepts: contributions, P/V ratios, margin of safety, angle of incidence, problems on marginal costing, break – even analysis with charts.

Capital Budgeting:

Meaning, kinds of capital budgeting (theory), problems on Payback period method, Accounting Rate of return method, Net present value (NPV) method, Internal rate of return method, Profitability index.

Tally software can be used to demonstrate business functionalities including accounting, finance, inventory, sales, purchase, point-of-sales, manufacturing, job costing, payroll and branch management.

Text books:

1. Management Accountancy: Sarkar.N.
2. Financial management: I.M.Pandey.
3. Accountancy: B.S.Raman
4. Management Accounting – Tools and techniques: N Vinayakam and Sinha
5. Principals of accounting, PHL: Levy and Samat

Note:

The **BRIDGE COURSE** entitled **Foundations of Information Technology** is a Non-Credit course for only B.Sc. / B.A. / B.Com with Mathematics at 10 + 2 Level or Graduation level.

The **BRIDGE COURSE** entitled **Accountancy and Financial Management** is a Non-Credit course for the students who take admission with BCA/B.Sc. degree with Computer Science as a cognate subject (With additional bridge Course as per the norms of the concerned University).

I Semester

Hardcore courses

Advanced Data Structures and Indexing (3:0:1)

Course Outcome:

- Understand the importance of various types of data structures in solving a problem through programming.
- Able to identify the suitability of a particular data structure to solve a problem.
- Critically evaluate the efficient representation of data structures in the memory.
- Elucidate the various operations performed on a particular data structure.
- Understand the importance of indexing and how it is achieved through a particular data structure.

Course Content

Unit – I:

Introduction, concept of data type, classification of data structures, abstract data types, Primitive data structures such as integer, real, character & Boolean, and their representation, Non-primitive data structures such as arrays, their representations, operations and applications, Linked lists, types of linked lists, operations on linked lists and their applications.

Unit-II

Introduction, representation, various operations and applications of stacks, queues, trees and graph data structures.

Unit-III

Introduction, representation, operations and applications of Height balanced trees, Weight balanced trees, B-trees, B+ trees, Red-Black trees, Splay trees and Skip lists, Interval trees, Segment trees, KD-trees, Quad trees and related structures with their applications.

Unit-IV

Impact of indices on query performance, basic structure of an index, Types of Indexing and its data structures.

Reference Books

1. Horowitz and Sahni, Fundamentals of Data Structures, W H Freeman & Co (June 1983).
2. Debasis Samantha, Classic Data Structures, PHI Learning Pvt. Ltd. 2nd Edition.
3. Aho, Ullman and Hopcroft, Data Structures and Algorithms, Addison Wesley (January 1983).
4. Jean-Paul, Tremblay and Sorenson, An introduction to data structures with applications, McGraw-Hill, 2nd Edition.
5. Peter Brass, Advanced Data Structures, Cambridge University Press, New York, 2008.

Object Oriented Programming with C++ (3:0:1)

Course Outcome:

- Justify the philosophy of object-oriented design and the concepts of encapsulation, abstraction, inheritance, and polymorphism.
- Design, implement, test, and debug simple programs in an object-oriented programming language.
- Describe how the class mechanism supports encapsulation and information hiding.
- Compare and contrast the notions of overloading and overriding methods in an object-oriented language.

Course Content:

Unit-I

Introduction: Procedure-oriented programming, Concepts of Object-oriented programming, benefits of OOP, Applications of OOP, Structure of C++ program.

Tokens, Keywords, Identifiers and constants, Basic Data Types, User-defined data types, derived data Types, Symbolic constants, Type compatibility, Declaration of variables,

Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Member dereferencing operators, Memory management operators, Manipulators, Type cast operator, Expressions and their types, Special assignment expressions, Implicit conversions, Operator overloading, Operator precedence, Control structures.

Unit –II

Functions: The main function, Function prototyping, Call by Reference, Return by Reference, Inline functions, Default arguments, const arguments, Function overloading, Friend and Virtual functions.

Classes and Objects: Specifying a Class, Defining member functions, Making an Outside function Inline, Nesting of member functions, Private member functions, Arrays within a Class, Static data members, Static member functions, Arrays of Objects, Objects as function arguments, friendly functions, Returning Objects, const member functions, Pointers to members.

Constructors and Destructors: Constructors, Parameterized constructors, Multiple constructors in a class, Constructors with default arguments, Dynamic initialization of objects, Copy constructor, Dynamic constructor, Constructing Two-dimensional arrays, const Objects, Destructors.

Unit –III

Operator overloading and Type Conversions: Defining operator overloading, Overloading unary operators, Overloading Binary operators, Rules for overloading operators, Type conversions.

Inheritance and Polymorphism: Introduction, defining derived classes, single inheritance, making a private member inheritable, multilevel inheritance, hierarchical inheritance, hybrid inheritance, virtual base classes, abstract classes, constructors in derived classes, polymorphism – introduction, pointers, pointers to objects, this pointers, pointers to derived classes, virtual functions, pure virtual functions.

Unit –IV

Console I/O Operations, Files and Templates: C++ streams, C++ stream classes, Unformatted I/O operations, Formatted I/O operations, managing output with manipulators.

Files: Classes for file stream operations, opening and closing a file, detecting end of file, more about open(): file modes, file pointers and their manipulations, sequential input and output operations.

Templates: Function templates, Class templates Exceptions.

Reference Books:

1. Object Oriented Programming with C++ , M.T. Somashekara, D.S. Guru, H.S. Nagendraswamy, K.S. Manjunatha, PHI Learning, New Delhi, 2012
2. Object Oriented Programming with C++ by E. Balagurusamy
3. Object Oriented Programming in C++ by Robert LaforeTechmedia Publication.
4. The complete reference C − by Herbert shieldt Tata McGraw Hill Publication.

Real Time Operating Systems (3:1:0)

Course Outcome:

- Understand the principles and methods for resource-analysis for embedded- and real-time systems.
- Acquire good knowledge of the relevant mechanisms and methods in operating systems and hardware that have influence on real-time aspects, principles and methods for design and construction of embedded- and real-time systems.

Course Content:

Unit –I

Introduction to OS and RTOS: Architecture of OS (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed & real –time O.S.

Process Management of OS/RTOS: Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept, Real Time Scheduling concepts.

Unit –II

Process synchronization and concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing, Monitors, Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem. Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies.

Unit –III

Memory and I/O Management: Memory Management requirements, Memory partitioning: Fixed, dynamic, partitioning, Buddy System Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging, Page Replacement Policies (FIFO, LRU, Optimal, clock) ,Thrashing, Working Set Model.

Unit –IV

I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches.

RTOS Application Domains: Comparison and study of RTOS: Vxworks and µCOS − Case studies: RTOS for Image Processing − Embedded RTOS for voice over IP − RTOS for fault Tolerant Applications − RTOS for Control Systems.

Reference Books:

1. Wayne Wolf, "Computers as Components: Principles ofEmbedded Computing system Design," 2/e, Kindle Publishers,2005.
2. Tanenbaum,"Modern Operating Systems," 3/e, Pearson Edition, 2007.
3. Jean J Labrosse,"Embedded Systems Building Blocks Completeand Ready-to-use Modules in C," 2/e, 1999.
4. C.M.Krishna and G.Shin, "Real Time Systems," McGraw-Hill International Edition, 1997.

Advanced Database Management System (3:0:1)

Course Outcome

- Understand the significance of databases, types of databases, merits and limitations of different DBMS.
- Explain and apply the concept of normalization for database design.
- Understand and apply concurrency control and transaction processing mechanisms.
- Learn the characteristics implementation of object oriented and distributed database management systems and their architecture.
- Understand the design techniques used in RDBMS, extension techniques in RDBMS, standards for OODBMS, products and applications.

Course Content

Unit-1:

Introduction: Comparison between different databases: Significance of Databases, Database System Applications, Advantages and Disadvantages of different Database Management systems, Comparison between DBMS, RDBMS, Distributed and Centralized DB.

Normalization: Functional Dependency, Anomalies in a Database, The normalization process: Conversion to first normal form, Conversion to second normal form, Conversion to third normal form, The boyce-code normal form (BCNF), Fourth Normal form and fifth normal form, normalization and database design, Denormalization

Unit-2:

Concurrency Control Serializability: Enforcing, Serializability by Locks, Locking Systems With Several, Lock Modes, Architecture for a Locking Scheduler Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Concurrency Control by Validation, Database recovery management

Transaction processing: Introduction of transaction processing, advantages and disadvantages of transaction processing system, online transaction processing system, serializability and recoverability, view serializability, resolving deadlock, distributed locking. Transaction management in multi-database system, long duration transaction, high-performance transaction system.

Unit–3:

Object Oriented DBMS Overview of object: oriented paradigm, OODBMS architectural approaches, Object identity, procedures and encapsulation, Object oriented data model: relationship, identifiers, Basic OODBMS terminology, Inheritance , Basic interface and class structure, Type hierarchies and inheritance, Type extents and persistent programming languages, OODBMS storage issues.

Distributed Database: Introduction of DDB, DDBMS architectures, Homogeneous and Heterogeneous databases, Distributed data storage, Advantages of Data Distribution, Disadvantages of Data Distribution Distributed transactions, Commit protocols, Availability, Concurrency control & recovery in distributed databases, Directory systems, Data Replication, Data Fragmentation. Distributed database transparency features, distribution transparency.

Unit-4

Object Relational and Extended Relational Databases: design techniques used in RDBMS, extension techniques in RDBMS, standards for OODBMS

Products and applications: ODMG-93 standards, ODMG Smalltalk binding, SQL3, Nested relations and collections, Storage and access methods , Implementation issues for extended type , Comparing RDBMS, OODBMS &ORDBMS.

Database application: Active database: starburst, oracle, DB2, chimera, Applications of active database, design principles for active rules, Temporal database, special, text and multimedia database. Video database management: storage management for video, video preprocessing for content representation and indexing, image and semantic-based query processing, real time buffer management.

Reference Books

1. Henry F Korth, Abraham Silberschatz and S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill, 2011.
2. C.J.Date, A.Kannan and S.Swamynathan,”An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
3. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson Education/Addison Wesley, 2007.

4. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
5. Subramaniam, “ Multimedia Databases”, Morgan Kauffman Publishers, 2008.

Softcore courses

Computer Graphics and Multimedia (3:0:1)

Course Outcome:

- Understand the basic concepts of computer graphics.
- Learn the implementation of algorithms to draw a line, circle, polygon, colour the objects, clipping the text and the object.
- Understand and implement the algorithms for 2D and 3D transformations.
- Learn the importance of viewing and projections.
- Understand the fundamentals of animation, virtual reality and its related technologies.
- Understand a typical graphics pipeline and implement the related algorithms.

Course Content

Unit - I

Introduction: Survey of computer Graphics and its applications; Interactive and passive graphics; A graphics system: Video display devices, raster scan and random scan system, The synthetic camera model; The programmer’s interface; Graphics architectures; Programmable pipelines; The OpenGL API, Primitives and attributes, Color Models – RGB, YIQ, CMY, HSV; Index color model; Viewing functions; Control functions; Graphics Programming: The Sierpinski gasket.

Unit - II

Interactive Graphics; Input devices: physical input devices and logical input devices, Clients and servers Model; Display lists; Graphics modeling using Display lists, Programming eventdriven input; Menus; Building animating interactive models. Geometry: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; 3-D Geometric transformations: Translation, rotation, scaling, reflection and

shear transformations; Matrix representations and Homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices.

Unit- III

Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera; Introduction to projections; Projections in OpenGL; Classifications of Projections; Parallel-projection ; Perspective-projection; Deriving Matrices for Parallel and Perspective Projections; Projections and shadows. Clipping and Rasterization; Clipping; Line-segment clipping Algorithms: Cohen–Sutherland algorithm, Liang–Barsky algorithm; Polygon clipping: Sutherland–Hodgman algorithm; Text Clipping; Rasterization; Line Drawing algorithms : Digital Differential Analyzer(DDA) algorithm, Bresenham's algorithm; Circle Drawing algorithm, Polygon rasterization: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms; Hidden-surface removal: Back face detection, Z-buffer method, Painter's algorithm, scan-line algorithm, BSP-trees, Area subdivision method, Ray tracing; Anti-aliasing.

Unit-IV

An Introduction; Multimedia applications; Multimedia System Architecture; Evolving technologies for Multimedia; Defining objects for Multimedia systems; Multimedia Data interface standards ; Multimedia Databases; Compression & Decompression ; Data & File Format standards; Digital voice and audio; video image and animation ; Full motion video ; Storage and retrieval Technologies; Multimedia Authoring & User Interface; Hypermedia messaging; Mobile Messaging; Virtual Reality.

Reference Books

1. Edward Angel,, Interactive Computer Graphics A Top-Down Approach with OpenGL 5th Edition, Addison-Wesley, 2008.
2. Prabat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003.
3. Donald Hearn and Pauline Baker, Computer Graphics - OpenGL Version 2nd Edition, Pearson Education, 2003.
4. F.S. Hill, Jr. , Computer Graphics Using OpenGL 2nd Edition, Pearson Education, 2001.
5. Ralf Steinmetz, Klara Narstedt, Multimedia Fundamentals: Vol 1-Media Coding and Content Processing 2nd Edition, Pearson Education / PHI, 2003.

Java Programming (3:0:1)

Course Outcome

- Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
- Read and make elementary modifications to Java programs that solve real-world problems.
- Validate input in a Java program, Identify and fix defects and common security issues in code.
- Document a Java program using Javadoc.
- Use a version control system to track source code in a project.

Course Content

Unit–I

Introduction to Java:Origin and features of Java. Java Program Structure, Java Tokens, Java statements, Java Virtual machine, Command Line Parameters, Java Variables and Data Types, Operators, Decision Making, Branching and looping statements.

Classes, Objects and Methods used in Java: Class fundamentals, Methods, Constructors, Overloading, Inheritance, Interfaces, One and two dimensional arrays, Vectors, Strings, Wrapper Classes.

Unit–II

Java Packages: API packages, system packages, naming conventions, creating and accessing a package, adding a class to a package, hiding classes.

Multi-threads Programming: Java thread Model, Main Thread, creating a Thread, Creating Multiple Threads, Extending the thread class, Stopping and blocking a thread, Life cycle of a thread, Managing Errors and Exceptions.

Unit–III

Applet Programming: Introduction, how applet differ from application, Applet life cycle, Applet tag, passing parameters to applet. Abstract Windows Toolkit: Components, Container, Panel, Label, Button, Checkbox, CheckboxGroup, Choice, List, TextField, TextArea, Scrollbars.

Graphics Programming: The Graphics class, Lines and Rectangles, Circles and Ellipses, Drawing Arcs, Drawing Polygons, Line Graphs, Using Control Loops in Applets.

Unit–IV

Managing Input/output Files in Java: Stream Classes, Byte Stream Classes, Character Stream Classes, Creation of Files, Reading/Writing characters, Reading/Writing Bytes, Handling Primitive Data Types, Concatenating and Buffering Files, Random Access Files.

Networking: Internet Address, TCP/IP Client Sockets, TCP/IP Server Sockets, URL, URL Connection, JDBC connectivity

Reference Books

1. Programming with Java – A PRIMER by - E.Balagurusamy, Tata McGraw-Hill 3rd Edition
2. The Complete Reference - Java-2 by- Patrick Naughton and Herbert Schildt Published by Tata McGraw-Hill India.
3. The Complete Reference – J2EE by - Jim Keogh, published by Tata McGraw-Hill.

Linux Programming (3:0:1)

Course Outcome:

- Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.
- Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.
- Monitor system performance and network activities.
- Effectively use software development tools including libraries, pre-processors, compilers, linkers, and make files. Comprehend technical documentation, prepare simple readable user documentation and adhere to style guidelines.
- Collaborate in teams on system tasks.

Course Content:

Unit–I:

Introduction, Features of Linux, Linux Utilities-File handling utilities, File permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities, sed – scripts, operation, addresses, commands, applications, awk – execution, fields and records, scripts, operation, patterns, actions, functions, using system commands in awk.

Unit–II:

Working with the Bourne shell(bash): Introduction, shell responsibilities, pipes and input Redirection, output redirection, running a shell script, the shell as a programming language control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

Unit–III:

Files: File Concept, File System Structure, Inodes, File Attributes, File types, Library functions,the standard I/O and formatted I/O in C, stream errors, kernel support for files, System calls, File structure related system calls(File APIs), file and record locking, file and directory management – Directory file APIs, Symbolic links & hard links. Process concept.

Unit –IV:

Multithreaded Programming: Differences between threads and processes, Thread structure and uses, Creating Threads, Thread Attributes, Thread Synchronization with semaphores and with Mutexes, Example programs. Sockets: Introduction to Sockets,example-client/server programs.

Reference Books:

1. Unix System Programming using C++, T.Chan, PHI.(UNIT III to UNIT VIII)
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones,Wrox, Wiley India Edition.
4. Advanced Programming in the Unix environment, 2nd Edition, W.R.Stevens, Pearson Education.
5. Unix Network Programming, W.R.Stevens, PHI.

E-Commerce and E-Governance (2:1:1)

Course Outcome:

- Understand the fundamentals of E-commerce, types and applications.
- Evaluate the role of the major types of information systems in a business environment and their relationship to each other.
- Assess the impact of internet and internet technology in a business electronic commerce and electronic business.
- Learn strategies for e-commerce, e-governance, wireless application protocol technology and electronic payment system.

Course Content

Unit–I

Introduction: Electronic commerce environment and opportunities: Background, The electronic commerce environment, Electronic market place technologies. Modes of electronic commerce: Overview, Electronic data interchange (EDI), Migration to open EDI, E-commerce with WWW/Internet, Commerce Net advocacy, Web commerce going forward.

Approaches to safe E-commerce: Overview, Secure Transport Protocols, Secure Transactions, Secure electronic payment protocol (SEPP), Secure electronic Transaction (SET), Certificates for authentication, Security on web commerce & Enterprise network.

Payments and Security: Electronic cash and Electronic payment Schemes: Internet monetary payment and Security requirements, payment and purchase order process, On-line electronic cash. Master card/Visa secured electronic transaction: Introduction, Business Requirements, Concepts, Payment processing.

Unit –II

Consumer-oriented e-commerce: Introduction, Traditional retailing and e-retailing, benefits of e-retailing, Key success factors, Models of e-retailing, features of e-retailing, developing a consumer-oriented e-commerce system, The PASS model. Business-oriented e-commerce: Features of B2B e-commerce, Business models, Integration. Web advertising and web publishing: Traditional versus internet advertising, Internet techniques and strategies, Business models for advertising and their Revenues streams, pricing models and measurement

of the effectiveness of Advertisements, web publishing- Goals and criteria, web side development Methodologies, logic design of the user interface.

Unit–III

E-Governance – An introduction, scope, Types of E- Governance- Public, Corporate, Urban, Public-Private Partnership. Models & issues for effective E-Governance.E-Democracy, role of E-Governance, E-Republic, E-Business.The stages of E-Government development, E-Govt Privacy, Security & Accessibility. Mobile security issues for E-Govt. ICT & E-Governance – Role of ICT(Information & Communication Technology). ICT infrastructure, Implementation of ICT policy.CRM(Customer Relationship Model)- Defining CRM in the public-service area. Standards in E-Governance, India Portal-Mission mode project, India development Gateway (InDG).

Unit–IV

E-Government in India- Introduction, Core policies, selection criteria, core infrastructure, support infrastructure, HRD/ Training- Technical assistance, awareness & assessment. National E-Governance Strategy, Implementation approach, governance structure. Draft policy Guidelines on website development-infrastructure, Applicability, Aims & Objectives, Content structure, website features, Administration, maintenance/updating, website promotion, technical aspects, security 7 secrecy of information, infrastructure & Training.

Reference Books

1. Ravi Kalakota, Andrew B. Frontiers of Electronic Commerce, Addison Wesley 1996.
2. Daniel Minoli, Emma Minoli: web commerce Technology Handbook. Tata McGraw Hill 1999.
3. Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Cheng: E-Commerce Fundamentals and applications, John Wiley & Sons, 2002.
4. E-Governance by - V.M. RAO
5. E-Governance by - PANKAJ SHARMA.

II Semester

Hardcore Courses

Data Communication and Networks (3:0:1)

Course Outcome:

- Understand the data communications system and its components.
- Summarize signal conversions techniques for digital communication.
- Identify and categorize various types of transmission media.
- Understand various analog and digital services for data communication.
- Evaluate bandwidth utilization using multiplexing techniques.
- Implement advanced technique such as Data encoding and Compression for Image processing Applications.

Course Content:

Unit –I

Data Communication, Component and Basic Concepts – Introduction, Characteristics – Delivery, Accuracy, Timeliness and Jitter, Components, Topology – Mesh, Star, Tree, Bus, Ring and Hybrid Topologies Transmission modes – Simplex, Half Duplex, Full Duplex Categories of networks – LAN, MAN, WAN, Network Components – Signal Transmission – Analog Signaling, concept of ASK, FSK, PSK, Digital Signaling, concept of Unipolar, Polar, Return-to-Zero(RZ), Biphase,

Unit –II

Manchester, Differential Manchester, Non-Return-to-Zero (NRZ), Bit Synchronization, Asynchronous Bit Synchronization and Synchronous Bit Synchronization, Baseband and Broadband Transmissions.

Transmission Media - Guided Media – Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable Unguided Media – Radio Wave Transmission Systems, Microwave Transmission Systems, Infrared Transmission Systems and Satellite Communication System.

Unit –III

The OSI Model – Functions of all the Seven Layers, Networking Devices – Functions and Applications of Hub, Switches, Bridges, Repeaters Internetworking Devices – Functions and

Applications of Routers and Gateways, IP Addressing – Dynamic IP Addressing, Static IP Addressing, Types of IP Addresses, Protocols –TCP, UDP, IP, IPV4, IPV6, TCP/IP Suite, SMTP,ARP, RARP, OSPF, BGP, ALOHA.

Unit–IV

Packet Switching Networks – Network Services and Internal Network Operations, Packet Network Topology, Datagrams and Virtual Circuits, Connectionless Packet Switching, Virtual Circuit Packet Switching.

Routing Concepts – Routing Tables, Dijkstra's Shortest Path Routing Algorithm, Flooding, Distance Vector Routing, Congestion Control Algorithms-Leaky Bucket Algorithm.

Data Link Issues –Single bit error and Burst Error, concepts of Redundancy, Checksum, Single Bit Error correction and Hamming Code correction method.

Reference Books:

1. Introduction to Data Communications and Networking by Behrouz Forouzan.
2. Computer Networks by Andrew S Tanenbaum.
3. Networking Essentials – Third Edition – Jeffrey S. Beasley, Piyasat Nilkaew

Artificial Intelligence (3:0:1)

Course Outcome

- Explain what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.
- Explain how Artificial Intelligence enables capabilities that are beyond conventional technology, for example, chess-playing computers, self-driving cars, robotic vacuum cleaners.
- Use classical Artificial Intelligence techniques, such as search algorithms, minimax algorithm, neural networks, tracking, robot localization.
- Ability to apply Artificial Intelligence techniques for problem solving.
- Explain the limitations of current Artificial Intelligence techniques.

Course Content

Unit-I

Introduction: Origin of AI, AI solution to problems, characteristics of AI problems; State space search - blind searches, heuristic searches; Search in game tree.

Unit-II

Predicate logic: Backward reasoning, Resolution; Other reasoning methods - Probabilistic, Fuzzy, Non monotonic

Unit-III

Knowledge representation: Overview of Semantic nets, Frames, Conceptual dependency, Scripts; Planning - Goal stack, Non linear, Hierarchical.

Unit-IV

Expert systems Learning: Rote, By Advice, By Analogy, Macro.

Reference Books

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar Nair, Tata McGraw Hill
2. Artificial Intelligence, Patrick Henry Winston, AWL
3. Artificial Intelligence and Expert Systems, Dan W. Patterson, PHI
4. Artificial Intelligence, Nils J Nilson, Elsevier, Morgan Kaufmann

Embedded Systems (3:1:0)

Course Outcome:

- Understand the composition, design, and implementation of embedded systems, the basics of interfacing hardware and software.
- Be familiar with both medium level and high level languages appropriate for embedded systems development techniques; reading and understanding processor and component datasheets; driving use contexts, including human-computer interaction, environmental sensing and actuation, etc.,

- Be familiar with working on a team to create and apply embedded systems and be exposed to history of embedded interfaces.

Course Content:

Unit –I

Introduction to Embedded Systems: Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

Unit –II

Embedded Networking: Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

Unit –III

Embedded Firmware Development Environment: Embedded Product Development Life Cycle-objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

Unit–IV

RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priorityinheritance, comparison of Real time Operating systems: Vx Works, чC/OS-II, RT Linux. Embedded System Application Development: Case Study of Washing Machine- Automotive Application- Smart card System Application.

Reference Books:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013.
2. Peckol, "Embedded system Design", John Wiley & Sons,2010
3. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
4. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
5. Elicia White," Making Embedded Systems", O' Reilly Series,SPD,2011.
6. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning,2009.
7. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

.Net with C# (2:1:1)

Course Outcome

- Understand the .Net frame work and the features of C# programming language to design and implement web-based applications as per the requirement.

Course Content:

Unit-I

Introduction: An overview of the .NET framework. CLR, FCL, ASP.NET to support Internet development and ADO.NET to support database applications. Languages supported by .NET, introduction to Visual Studio .NET.

Unit-II

Introduction to C#: Program structure, Basic IO, data types, operators and expressions, relational and logical operations, control structures. Writing methods, Recursion and overloading arrays and data representation. Class definitions. Properties, indexers, and access Arrays control. Inheritance and polymorphism, delegates. Exception handling.

Unit-III

ADO.NET: Introduction to SQL. ADO.NET after Native Drivers, ODBC Drivers, DAO/RDO and ADO. Database using VS.NET Establishing Connection with Database.

Unit- IV

ASP.NET: Web forms in ASP.NET, States, Validation, Login; ASP.NET Administrative tasks ASP.NET Data controls, Ajax Extensions, LINQ, Working with XML data, Web Services.

Reference Books

1. Pro C# with .NET 3.0 by Andrew Troelsen.
2. Microsoft ASP.NET by G.Andrew Duthie.
3. Building ASP.NET WebPages with Microsoft web Matrix. By Steve Lydford

Softcore courses

Linear Algebra and Probability Distribution (3:1:0)

Course Outcome

- Understand the concept and applications of vector spaces, subspaces and linear independence.
- Understand various inner products and able to perform various inner product operations.
- Explore the applicability of general Liner Transformations, Linear operators, Composition of operators and linear transformations.
- Understand the basics of probability theory and its applications

Course Content

Unit-I

Vector Spaces: General Vector Spaces, Subspaces, Linear Independence, Basis and Dimension, Span, Some Fundamental Theorems, Row Space, Column Space, Nullspace, Rank and Nullity, Four Fundamental Spaces,

Unit-II

Inner Product Spaces: General Inner Products, Euclidean and Weighted Inner Product, Length, Distance, Norm, Angle and Orthogonality in Inner Product Spaces, Caucy-Schwarz

Inequality, Orthogonal Complement, Orthonormal Bases, Gram-Schmidt Procedure, QR-decomposition.

Unit-III

Linear Transformations: General Liner Transformations, Linear operators, Composition of operators and linear transformations, Kernel and Range, Dimension theorem for Linear Transformation, Inverse Linear Transformations, Matrices of General Linear Transformations, Matrices of Compositions and Linear Transformations.

Unit-IV

Probability Theory: Basics of Probability theory, Discrete Random Variables and Probability Distributions, Mean and Variance, Moments of a Discrete Random Variable, Uniform Distribution, Binomial Distribution, Poisson Distribution, Functions of Random Variables, Continuous Random Variables and Probability Distributions

Text Books/References:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", John Wiley and Sons, 9th Edition, 2008.
2. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", John Wiley and Sons, 3rd Edition, 2003.

Cloud Computing (3:1:0)

Course Outcome:

- Define Cloud Computing and memorize the different Cloud service and deployment models.
- Describe importance of virtualization along with their technologies.
- Use and Examine different cloud computing services.
- Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing.
- Design & develop backup strategies for cloud data based on features.

Course Content

Unit–I

Introduction: Cloud models-Evolution of Cloud Computing –System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – On-demand Provisioning – Elasticity in Cloud – deployment models – service models-cloud service providers.

Virtualization: Basics of Virtualization- Types of Virtualization- Implementation Levels of Virtualization, Virtualization Structures - Tools and Mechanisms – resource sharing and resource pooling Desktop Virtualization – Server Virtualization.

Unit–II

Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

Unit–III

Programming Model: Parallel and Distributed Programming Paradigms – Map Reduce, Twister and Iterative Map Reduce – Hadoop Library from Apache – Mapping Applications - Programming Support.

Security in the Cloud: Security Overview – Cloud Security Challenges – Access control mechanisms – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Virtual Machine Security.

Unit–IV

Enterprise Cloud-Based High Performance Computing (HPC): Overview of High Performance Computing (HPC) on Cloud-Enterprises HPC applications (high-performance grid computing, high-performance big data computing/analytics, high performance reasoning)- HPC Cloud vendor solutions: compute grids (Windows HPC, Hadoop, Platform Symphony ,Gridgain), data grids (Oracle coherence, IBM Object grid, Cassendra, HBase, Memcached, HPChardware (GPGPU, SSD, Infiniband, Non-blocking switches)

Setting up own cloud: Cloud setup-How to build private cloud using open source tools-Understanding various cloud plugins- Setting up your own cloud environment-Auto

provisioning- Custom images-Integrating tools like Nagio-Integration of Public and Private cloud.

Reference Books

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing, From
2. Parallel Processing to the Internet of Things, 2012, 1st Edition, Morgan Kaufmann Publishers.
3. Katarina Stanoevska-Slabeva, Thomas Wozniak, SantiRistol, Grid and Cloud Computing – A Business Perspective on Technology and Applications, 2010, Springer.
4. John W.Rittinghouse and James F.Ransome, Cloud Computing: Implementation, Management, and Security**"**, 2010, CRC Press.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, 2009, TMH.
6. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud O'Reilly, 2009.

Data Mining and Data Warehousing (3:1:0)

Course Outcome

- Acquire the knowledge of data preprocessing and data quality; modeling and design of data warehouses and algorithms for data mining.
- Be able to design data warehouses and apply acquired knowledge for understanding data and select suitable methods for data analysis.

Course Content

Unit-I

Introduction to data mining and Data Warehousing, Modeling: Data Cube and OLAP, Data Warehouse Implementation, Data Mining – types of data, types of patterns, Data cleaning, Data integration.

Unit-II

Data Reduction, Wavelet Transforms, Attribute Subset Selection, Histogram, Clustering, Sampling, Data Cube Aggregation Data Transformation: Strategies Overview, Data Transformation by Normalization.

UNIT-III

Mining Frequent Patterns, Associations & Correlations: pattern evaluation methods. Classification, Decision tree Induction, Attribute Selection Measures, Tree Pruning, Bayes Classification Methods.

Unit-IV

Cluster Analysis: Requirement for Cluster Analysis, clustering methods Data Mining Applications & Trends: Mining Sequence Data; Time Series, Symbolic, Statistical Data Mining, Visual Data Mining, Data Mining Applications.

Reference Books:

1. Jiawei Micheline Kamber, 'Data Mining Concepts and Techniques', Morgan Kauf Mann Publishers.
2. George M. Marakas, 'Modern Data Warehousing, Mining and Visualization', Pearson Education, 2003.
3. W.H. Inmon, 'Building the Data Warehouse', Wiley dreamtech, 3rd Edition.
4. Mastering Data Mining – Michael J.A. Berry & Gordon S. Linoff (Wiley Pub.).
5. Data Warehousing (Pearson Ed.) – Sam Anahory & Dennis Murray.

Cryptography and Network Security (3:1:0)

Course Outcome

- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical.
- Compare and Contrast different IEEE standards and electronic mail security.

Course Content

Unit–I

Introduction-computer security concepts, attacks, security services, security mechanisms; Classical encryption techniques-symmetric cipher models, substitution techniques, transposition techniques, rotor machines

Unit–II

Symmetric ciphers-Block cipher principles; DES-Algorithm, strengths and weaknesses of DES, attacks on DES and defense, multiple encryptions; Asymmetric ciphers-Essential mathematics, public key cryptography.

Unit–III

RSA, Diffie Hellman key exchange, random number generation, Data integrity and authentication Hash functions; MAC; Digital signatures;

Unit–IV

Key management; Authentication, Web and system security, Web security; IP security; E mail security; System security-intruders, malicious software, firewalls

References Books

1. Cryptography and Network Security - Principles and Practice, William Stallings, PEARSON
2. Cryptography and Network Security, AtulKahate, Tata McGraw Hill

III Semester

Hardcore Courses

Theory of Complexity (3:0:1)

Course Outcome

- Understand the notion of algorithm and its complexity.
- Able to compute tte time and space complexity of an algorithm.
- Able to analyse practical problems and classify them according to their complexity.
- Be familiar with the phenomenon of NP-completeness, and be able to identify problems that are NP-complete.
- Be aware of a variety of complexity classes and their interrelationships.

Course Content

Unit-I

The notion of an algorithm. Complexity of algorithms and of problems. Lower and upper bounds. Examples: sorting and travelling salesman. Models of computation and measures of complexity. Time and space complexity on a Turing machine. Decidability and complexity. Machine models for computations: variants of Turing machines and their equivalence.

Unit-II

Complexity theory: complexity hierarchies, effective reducibility, the P=NP problem, NP-complete problems, complexity of various decidability problems in logic and automata theory, Savitch's theorem.

Unit-III

The polynomial hierarchy. Boolean functions and circuits. First and second order logic complexity and their relation to complexity classes. The relativized P=NP-problem. Probabilistic algorithms and their complexity theory. Lower bounds for proof lengths in systems of proposition logic.

Unit-IV

Complexity for other computational models, such as exact real arithmetic, higher type functionals, and quantum computations. The time and space hierarchy theorems and complete problems. Logics capturing complexity classes. Fagin's theorem.

Reference Books

1. Papadimitriou (1994). Computational complexity. Addison-Wesley.
2. Goldreich (2008). Computational complexity: A conceptual perspective. Cambridge University Press.
3. Sipser, M. (1997). Introduction to the theory of computation. PWS.

Advanced Software Engineering (3:1:0)

Course Outcome:

- Identify unique features of various software application domains and classify software applications.
- Choose and apply appropriate lifecycle model of software development.
- Identify user needs and formulate software specifications, analyze requirements by applying various modeling techniques, Translate the requirements model into the design model.
- Understand the importance of User-interface design principles in software development, the concepts of clean room software development.
- Classify CASE tools and their applicability in software development.
- Understand the principles of agile development and distinguish agile process model from other process models.
- Learn the emerging trends in software development.

Course Content:

Unit-I

Introduction: The role of software engineering in system design, software products, emergence of software engineering, notable changes in software development practices, the changing nature of software, the software engineering challenges, software processes, desired characteristics of software process, the software life cycle, software development process models, comparison of process models.

Software Requirement Specification: Requirement analysis, need for SRS, characteristics of SRS, organization of SRS document, techniques for representing complex logic, functional specification with Use Cases, formal system development techniques.

Unit-II

Software Design: Introduction, cohesion and coupling, software design approaches, design principles, module level concepts, Function-oriented software design, Object-oriented software design concepts: Overview, UML, object-oriented design methodology, OOD metrics and goodness criteria, user interface design concepts.

Coding and Testing: Coding standards, guidelines, code walkthroughs, code inspections, software documentation, unit testing, black box testing, white box testing. Debugging, approaches and guidelines, program analysis tools, integration testing, system testing, general issues associated with testing.

Unit-III

Software Project Management: Main objectives of SPM, responsibility of software project managers, project planning, structure of software project management document, project size estimation metrics, project estimation techniques, project scheduling and staffing, work break down structure, Gantt charts, PERT charts, organization and team structures, attributes of a good software engineer, risk management and configuration management, software maintenance process models, estimation of maintenance costs, CASE and its scope, CASE support in software life cycle, characteristics of CASE tools, architecture of CASE environment.

Software Quality Management: Software quality factors, quality metrics, software quality management system, software reliability metrics, software reliability specification, reliability growth modeling.

Unit-IV

Emerging Technologies: Agile software development concepts, Security concepts, security risk management, design for security, system survivability. Service-oriented software engineering- services as reusable components, service engineering, software development with services. Aspect- oriented software development- The separation of concerns, aspects, join points and point cuts, software engineering with aspects.

References Books:

1. Software Engineering, Ian Sommerville, 8th Edition, Pearson Education Ltd.,
2. Software Engineering – A practitioners approach, Roger. S. Pressman, Tata-McGraw Hill 6th Edition.
3. Fundamentals of software engineering, Rajib Mall, Phi learning Pvt. Ltd, 3rd edition.
4. Pankaj Jalote – An Integrated Approach to Software Engineering, Third Edition.
5. Ghezzi, Jazayeri, Mandrioli – Fundamentals of Software Engineering, PHI.

Python Programming (2:0:2)

Course Outcome

- Acquire programming skills in core Python. Acquire Object Oriented Skills in Python.
- Develop the skill of designing Graphical user Interfaces in Python.
- Develop an ability to write database applications in Python.

Course Content

Unit-I

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

Unit-II

Types, Operators and Expressions: Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass.

Data Structures Lists: Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

Unit-III

Functions: Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

Unit-IV

Object-Oriented Programming OOP in Python: Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions.

Brief Tour of the Standard Library: Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

Reference Books

1. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd.
2. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2011.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015.

4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, **"**Data Structures and Algorithms in Python**"**,1st Edition, Wiley India Pvt Ltd, 2016.
5. ReemaThareja, **"**Python Programming using problem solving approach**"**, Oxford university press, 2017.
6. Python Programming: A Modern Approach, VamsiKurama, Pearson
7. Learning Python, Mark Lutz, Orielly
8. Introduction to Python, Kenneth A. Lambert, Cengage.

Machine Learning (3:0:1)

Course Outcome

- Gain knowledge about basic concepts of Machine Learning.
- Identify machine learning techniques suitable for a given problem.
- Solve the problems using various machine learning techniques
- Design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Content

Unit-I

Introduction, Machine learning definition, importance of machine learning, machine learning framework, types of machine learning, relation to other fields, examples of machine learning applications, designing a learning system, issues in machine learning.

Unit-II

Introduction to Supervised Learning, Decision tree based classifier, Bayesian theory based classifier, Neural network based classifier, Nearest neighbour classifier, Support vector classifier, performance evaluation.

Unit-III

Introduction to Unsupervised Learning, Clustering methods, Criteria functions for clustering, Similarity measures, Component analysis, Low dimensional analysis and multidimensional scaling.

Unit-IV

Additional topics, Reinforcement learning, Genetic algorithms, Analytical learning, Ensemble of classifiers, Design and analysis of machine learning experiments.

Reference Books

1. Machine Learning: a Probabilistic Perspective by Kevin Patrick Murphy, MIT Press, March 2014.
2. Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan, Cambridge University Press.
3. Understanding Machine Learning: From Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David
4. Published 2014 by Cambridge University Press.

Softcore Courses

Digital Image Processing (2:0:2)

Course Outcome:

- Develop and implement algorithms for digital image processing.
- Apply image processing algorithms for practical object recognition applications.

Course Content

Unit–I

Introduction to digital image processing, Stages, Application areas, components, electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, relationships between pixels, Enhancement in spatial domain: Intensity transformation functions.

Unit–II

Spatial filtering, Frequency domain enhancement: Discrete Fourier transform (DFT) properties of the 2D discrete Fourier transform, filtering in the frequency domain, Introduction to Color image processing.

Unit–III

Segmentation – Intensity based – point, line and edge. Region based – Boundaries, region growing, Thresholding, splitting and merging, segmentation by morphological watersheds, the use of motion in segmentation.

Unit–IV

Morphological operations: Preliminaries, opening and closing, the hit-or-miss transformation, some basic morphological algorithms, gray-scale images. Image representation.

Some applications: Document image processing, Biometrics, robot vision, medical applications.

Reference Books

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, 3-rd ed. Prentice Hall, Pearson publication.
2. Anil K Jain, Digitial Image Processing, PHI Publication
3. Milan Sonka, Image Processing, Analysis, and Machine Vision, 3rd Edition, CL Engineering(2013)

Internet of Things (2:0:2)

Course Outcome

- Understand the key technologies in internet of things, wireless sensor network architecture and its framework along with WSN applications,
- Understand the resource management and business models for the internet of things.

Course Content

Unit–I

Introduction to IoT: Definition and Characteristics, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies.

M2M and IoT: Introduction to M2M**,** Difference between IoT and M2M, SDN and NFV for IoT.

IoT Protocols: IEEE 802.15.4, BACNet Protocol, Modbus, KNX, Zigbee Architecture, 6LoWPAN, RPL

Unit–II

Developing Internet of Things: IoT Platforms Design Methodology, Python packages of Interest for IoT, IoT Physical Devices and Endpoints.

IoT and Cloud: IoT Physical Servers and Cloud Offerings, IoT Tools: Chef, Puppet.

Unit–III

Data Analytics for IoT: Big Data Platforms for the IoT, Hadoop Map Reduce for Batch Data Analysis, Apache Oozie Workflows for IoT Data Analysis, In-Memory Analytics using Apache Spark, Apache Storm for Real Time Data Analysis, Sustainability Data and Analytics in Cloud based M2M Systems, Fog Computing: A Platform for IoT and Analytics

Unit–IV

Domain Specific IoTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle, Virtual Reality Internet Advertising, Intelligent Transportation Systems, Health Information System: Genomics Driven Wellness Tracking and Management System (Go-WELL).

Reference Books

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach, 2015, 1st Edition, Universities Press.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things – Key applications and Protocols, 2012, Wiley Publication.

3. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, 2012, CRC Press.
4. Dieter Uckelmann; Mark Harrison; Florian Michahelles Architecting the Internet of Things,

Mobile Application Design and Development (2:0:2)

Course Outcome

- Describe Android platform, Architecture and features.
- Design User Interface and develop activity for Android App.
- Use intent, broad cast receivers and internet services in Android App.
- Design and implement Database Application and Content providers.
- Use multimedia, camera and Location based services in Android App.
- Discuss various security issues in Android platform.

Course Content:

Unit–I

Mobile application development: A brief history of mobile**,** Mobile ecosystem, Designing for context, Developing a Mobile Strategy, Mobile Information Architecture, Mobile Design, Types of mobile application

Unit –II

Technologies: HTML5-elements, form, graphics, media, CSS3-2Dtransforms, 3Dtransforms, transitions, animations, images, Javascript-forms, objects, error handling, validations, JQuery-selectors, effects, traversing, Ajax

Unit –III

Android programming: Android toolkit, Java for android, components of an Android Application.

Android software development: Eclipse Concepts and Terminology, Eclipse Views and Perspectives, Eclipse and Android, Effective java for Android.

Android Framework: Building a View, Fragments and Multiplatform Support, Handling and Persisting Data.

Android UID principles: Designing powerful user interfaces, handling advanced user input, designing accessible applications.

Unit–IV

Drawing, Animations and Graphics programming: Developing 2D graphics applications, working with animations developing Android 3D graphics applications, using Android NDK.

Reference Books

1. ZigurdMednieks, Laird Dornin, G. Blake Meike, and Masumi Nakamura, Programming Android, 2011, 1st Edition, O'Reilly Media.
2. Jonathan Stark, Building iPhone Apps with HTML, CSS and JavaScript, 2011, 1st Edition, O'Reilly Media.
3. Brian fling, Mobile Design and Development, 2009,1st Edition, O'Reilly Media.
4. Paul Deitel, Harvey Deitel, Abbey Deitel, Michael Morgana, Android for Programmers An App-Driven Approach, 2012, 2nd Edition, Deitel Developer Series, Pearson Education.

Big Data Analytics (2:0:2)

Course Outcome

- Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
- Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
- Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
- Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Course Content

Unit–I

Introduction to Big Data Analytics: Big Data Overview, State of practice in analytics, Role of Data Scientists, Examples of Big Data Analytics, Data Analytics Lifecycle, Components of Hadoop, Analyzing Big data with Hadoop, Design of HDFS, Developing a Map reduce Application.

Unit-II

Map Reduce: Distributed File System(DFS), Map Reduce, Algorithms using Map Reduce, Communication cost Model, Graph Model for Map Reduce Problem.

Unit–III

Hadoop Environment: Setting up a Hadoop Cluster, Hadoop Configuration, Security in Hadoop, Administering Hadoop, Hadoop Benchmarks, Hadoop in the cloud.

Big Data Analytics Methods using R: Introduction to R-Attributes, R Graphical user interfaces, Data import and export, attribute and Data Types, Descriptive Statistics, Exploratory Data Analysis.

Unit–IV

Statistical methods for evaluation: Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I and Type II errors, power and sample size, ANOVA.

Advanced Analytics - technologies and tools: Analytics for unstructured data, The Hadoop ecosystem – pig – Hive- HBase- Mahout- NoSQL.

Reference Books

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services, 2015, publishing.
2. Anand Raja Raman and Jeffrey David Ullman, Mining of Massive Datasets, 2012, Cambridge University Press.
3. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'Reilly Media

Skill Enhancement Courses

Letex Documentation Tool (1:0:1)

Course Outcome

- Understanding the overall features supported by Latex tool to prepare flawless, elegant and descriptive documents.
- Able to prepare any type of document such as Project Dissertation, Ph.D. Thesis, research articles, survey papers etc., incorporating the required features supported by the Latex tool.

Course Content

Unit-1

Introduction, LATEX Syntax-Commands, Environments, Packages; Keyboard Characters in LATEX; Fonts Selection-Text-Mode Fonts, Math-Mode Fonts, Emphasized Fonts, Colour Fonts; Formatting Texts-Sectional Units, Labelling and Referring Numbered Items, Texts Alignment, Quoted Texts, New Lines and Paragraphs, Creating and Filling Blank Space, Producing Dashes Within Texts, Preventing Line Break, Adjusting Blank Space After a Period Mark, Hyphenating a Word, Increasing Depth of Sectional Units, Changing Titles and Counters of Sectional Units, Multiple Columns, Mini Pages, Foot, Marginal Notes.

Unit-2

Page Layout and Style-Page Layout, Page Style, Running Header and Footer, Page Breaking and Adjustment, Page Numbering; Listing and Tabbing Texts-Listing Texts, Tabbing Texts Through the tabbing Environment; Table preparation, Figure Insertion, Figure Drawing, Equation Writing, User-Defined Macros, Bibliography with LATEX, Bibliography with BIBTEX Program, Lists of Contents and Index, Letter and Article, Book and Report, Slide Preparation, Error and Warning Messages, Miscellaneous.

Reference Books

1. Dilip Datta, Latex in 24 Hours, A Practical Guide for Scientific Writing, Springer International Publishing AG 2017. ISBN 978-3-319-47831-9.
2. Goossens M, Mittelbach F, Samarin A (1994) The LATEX companion. Addison-Wesley Publishing Company.

3. Goossens M, Rahtz S, Mittelbach F (1997) The LATEX graphics companion. Addison-Wesley, Longman Inc.
4. Harvey J, Greenberg A (2000) Simplified introduction to LATEX. Technical report, Mathematics Department, University of Colorado at Denver.
5. Kopka H, Daly PW (1995) A guide to LATEX2ε. Addison-Wesley, Harlow.
6. Lamport L (1994) LATEX: user's guide and reference manual. Pearson Education, Englewood Cliffs.
7. Frank M, Michel G, Johannes B, David C, Chris R (2004) The LATEX companion. Addison-Wesley, Boston.
8. Oetiker T, Partl H, Hyna I, Schlegl E (2006) The not so short introduction to LATEX2ε. Technical report. https://www.CTAN.org/tex-archive/info/lshort.

Project Methodology and Documentation (1:0:1)

Course Outcome

- Able to identify the need of designing and development of computer application for real world problem, perform feasibility analysis and problem formulation.
- Understand the types of project such as research project, applied project and their features.
- Understand the importance of project design, features of good project design, experimental design in any project work.
- Understand the concept of measurement, sampling, data analysis, interpretation and documentation.

Course Content

Unit-1

Overview of Project: Meaning, purpose, significance of ethical conduct in project, Classification of project based on its purpose (Basic, Applied, Evaluation and Action).

Scientific Thinking: Types of reasoning, Critical Thinking, Importance of existing knowledgebase (review of literature)

Elements of Project: Concepts, Constructs, Definitions – Theoretical and Operational, Theory, Literature Review and its importance, Models, questions and objectives, project design and methodology.

Unit-2

Qualitative and Quantitative Project, Concept of measurement, Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response, Characteristics of a good sample, Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling, Determining size of the sample, Practical considerations in sampling and sample size.

Data Analysis: Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Interpretation of Data and Project Documentation: Organization of a project report, overview of the problem statement, scope and domain, review of literature related to the problem domain, identifying the technical gap to be addressed, motivation for the problem statement, challenges and issues to be addressed, expected outcomes of the project work, overall framework of the proposed project work, implementation platform and bibliography.

Reference Books:

1. The Practical Guide to Project Management Documentation by John Rakos et al., John Wiley & Sons, Inc. Hoboken, New Jersey, December 2004.
2. Fundamentals of Project management by James P. Lewis, Third edition.
3. Fundamentals of Project management by Joseph Heagney, Fifth edition.
4. Guide to Project Management by Paul Roberts, Second Edition

IV Semester

Hardcore Courses

Project Work (0:2:10)

Course Outcome:

- Able to identify and formulate the real time problem (application development or research related) by extensively studying the recent literature and identifying the research or application gap.
- Understand and get the practical exposure to the tools and technology needed to implement the solution to the problem defined.
- Critically evaluate the performance of the application/algorithm designed by conducting extensive experiments on various test cases and comparing the results with the state-of-the art applications/algorithms.
- Able to learn how to precisely document the dissertation work carried out using the various documenting and diagrammatic tools.

Reference Books

1. Recent literature available in various portals/websites.
2. Books/Manuals related to the problem domain and implementation platform.
3. Research articles published in various journals and conferences.

Softcore Courses

Skill Enhancement Course

Communication Skills and Professional Management (3:1:0)

Course Outcome

- Communicate, interact and present his ideas to the other professionals.
- Understand and aware of importance, role and contents of soft skills through instructions, knowledge acquisition, demonstration and practice.
- Have right attitudinal and behavioral aspects, and build the same through activities.
- Possess right professional and social ethical values.

Course Content

Unit–I

Importance of communication, its basic model, formal and informal communications, barriers to communication, feedback and its effectiveness, conflict communication.

Unit–II

Oral communication – influencing factors, self confidence, role of trust, motivational factors, style, importance of listening, role of visual arts, informative and persuasive communication.

Unit–III

Written communication – writing style, important of writing skills, book review and disadvantages over oral communication. Letter writing – formal and informal letters, official and demi-official letters, business and commercial letters, personal correspondence. Technical report writing and effective meeting.

Unit–IV

Support by word processing systems, LOTUS, Graphics software for Professional Management.

References Books

1. Effective Communication made simple – Rupa & Co.
2. Communication for results – C Hamilton & Parker
3. Instrument of Communication – P Meredith
4. Basic Management skills for all – E H McGrath
5. Managerial Communication – P M Timm
6. Thesis and Assignment writing - Anderson

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