

**R.T.M. NAGPUR UNIVERSITY, NAGPUR**  
**SCHEME FOR M.Sc. (COMPUTER SCIENCE)**

Sr. No.	M.Sc. Part I Semester-1	Teaching Scheme per week (hrs.)			Credits	Examination Scheme					
		Th.	Pr	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing	
							External Marks	Internal Marks		Th.	Pr.
1	Discrete Mathematical Structure	4	-	4	4	3			100	40	
2	Programming in Java	4	-	4	4	3			100	40	
3	Digital Electronics and Microprocessor	4	-	4	4	3			100	40	
4	Advanced DBMS and Administration	4	-	4	4	3			100	40	
5	Practical-I based on theory paper-1 and 2	-	8	8	4	4	80	20	100	--	40
6	Practical-II based on theory paper-3 and 4	-	8	8	4	4	80	20	100	--	40
7	Seminar			2	1	0.5			25	10	
	<b>Total</b>	16	16	34	25	-			625	170	80

Sr. No.	M.Sc. Part I Semester-2	Teaching Scheme per week (hrs.)			Credits	Examination Scheme					
		Th	Pr	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing	
							External Marks	Internal Marks		Th.	Pr.
1	Windows Programming using VC++	4	-	4	4	3			100	40	
2	Theory of Computation and Compiler Construction	4	-	4	4	3			100	40	
3	Computer Architecture and Organization	4	-	4	4	3			100	40	
4	Computer Graphics	4	-	4	4	3			100	40	
5	Practical-I based on theory paper-1 and 2	-	8	8	4	4	80	20	100	--	40
6	Practical-II based on theory paper-3 and 4	-	8	8	4	4	80	20	100	--	40
7	Seminar			2	1	0.5			25	10	
	<b>Total</b>	16	16	34	25	-			625	170	80

Sr. No.	M.Sc. Final Semester-3	Teaching Scheme per week (hrs.)			Credits	Examination Scheme					
		Th	Pr	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing	
							External Marks	Internal Marks		Th.	Pr.
1	Data Communication and Networks	4	-	4	4	3			100	40	
2	Software Engineering	4	-	4	4	3			100	40	
3	Neural Network	4	-	4	4	3			100	40	
4	Elective-1 1.1 Mobile Computing 1.2 Multimedia Technologies 1.3 ASP.NET	4	-	4	4	3			100	40	
5	Practical-I based on theory paper-1 and 2	-	8	8	4	4	80	20	100	--	40
6	Practical-II based on theory paper-3 and 4	-	8	8	4	4	80	20	100	--	40
7	Seminar			2	1	0.5			25	10	
	<b>Total</b>	<b>16</b>	<b>16</b>	<b>34</b>	<b>25</b>	<b>-</b>			<b>625</b>	<b>170</b>	<b>80</b>

Sr. No.	M.Sc. Final Semester-4	Teaching Scheme per week (hrs.)			Credits	Examination Scheme					
		Th	Pr	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing	
							External Marks	Internal Marks		Th.	Pr.
1	Data Mining	4	-	4	4	3			100	40	
2	Artificial Intelligence & Expert System	4	-	4	4	3			100	40	
3	Design and Analysis of Algorithm	4	-	4	4	3			100	40	
4	Elective-2 2.1 Embedded System 2.2 Pattern Recognition 2.3 Parallel Computing	4	-	4	4	3			100	40	
5	Practical-I based on theory paper-1 to 4	-	8	8	4	4	80	20	100	--	40
6	Project	-	8	8	4	3	80	20	100	--	40
7	Seminar			2	1	0.5			25	10	
	<b>Total</b>	<b>16</b>	<b>16</b>	<b>34</b>	<b>25</b>	<b>-</b>			<b>625</b>	<b>170</b>	<b>80</b>

**M.Sc. Part I**  
**Semester -1**

**Paper I : Discrete Mathematical Structure**

**Hours/Week : 4**

**Credits : 4**

**Unit-1 :**

Fundamental – Sets and Subsets, operations on sets, sequence, Division in the integer, Matrices, Mathematics Structures. Logic-Proposition and Logical Operation Conditional Statements, Methods of Proof, Mathematical Induction, Mathematics Logic- Statements and Notation, Connectives ,Normal Forms ,The Theory of Interface for the statement Calculus ,Inference Theory of the Predicate Calculus,

**Unit-2 :**

Counting- Permutation, Combination, The pigeonhole Principle, Recurrence Relations. Relational and Digraphs- Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs Properties of Relations, Equivalence Relations, Computer Representation of Relations and Digraph, Manipulation of Relations, Transitive Closure and Warshall's Algorithms. Functions-Definition and Introduction, Function for Computer Science, Permutation Functions, Growth of Functions.

**Unit-3 :**

Graph Theory : Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits. Other relations and Structure- Partially Ordered Sets, Lattices Finite Boolean-Algebra, Functions of Boolean Algebra's, Boolean function as Boolean Polynomials. Tree-Introduction Unidirected Tree, Minimal Spanning Trees.

**Unit-4 :**

Semigroups and Groups: Binary Operations Revisited, Semigroups, Products and Quotations of Groups. Introduction to computability –Languages Finite –State Machines, Semigroup, Machines and Language.

**Books :**

1. Discrete Mathematical Structures By Bernard Kolman c, Busby & Sharon Ross [PHI]
2. Discrete Mathematical Structures with Application to computer science By J.P.Tremblay & R.Manohar [Tata McGraw –Hill]
3. Combinational Mathematics By.C.J.Liu

**Reference Books:**

1. Discrete Mathematics with Graph Theory By Goodaire [PHI]
2. Discrete Mathematics by J.K.Sharma (McMillan)
3. Discrete Mathematics and its Applications By Kenneth Rosen (TMH)
4. Discrete Mathematics By Seymour Lipschutz, Marc Lipson (TMH)
5. Discrete Mathematics : Rajendra Akerkar, Pearson

## Paper II : Programming in Java

Hours/Week : 4

Credits : 4

### Unit-1 :

Java and Internet, Features of java: security, portability, multithreading, etc, Bytecode, Datatypes, variables and Arrays, Operators, Classes : declaring objects, methods, constructor, overloading constructor, garbage collection, finalize() method, static variable and method, final variable, command line argument. Inheritance: super keyword, final with inheritance. Packages and Interfaces.

Exception handling : Overview, types, Uncaught exception, try -catch block, multiple catch, nested try, throw, throws, finally, built-in and user- defined exception.

Multithreading : Life Cycle, Thread class and Runnable Interface, isAlive(), join(), Priorities, Synchronization : sleep() , run(). Interthread communication : wait(), notify(), notifyAll(), deadlock. String Handling.

### Unit-2:

Wrapper classes, Applet: Applet Class, Architecture, Life Cycle, Display methods, HTML APPLET Tag, Passing parameter to Applet

AWT : working with Windows, Controls, Layout Manager, Menus. Swings. Event handling.

### Unit-3:

JDBC : Architecture, JDBC-ODBC bridge driver, SQL Package, ResultSet and its methods.

Networking : Socket, Reserve socket, Internet Addressing, InetAddress, TCP/IP client socket, TCP/IP server socket, URL, URL Connection, Datagram.

RMI : Introduction, Architecture, Remote Interface, java.rmi. server package, class naming, creating Rmi server and client ,transmitting files using rmi, client side callback, RMISECURITYMANAGER class, RMI Exception, Stub and Skeleton.

### Unit-4:

Servlet : Life Cycle, Tomcat, javax. servlet package, reading servlet parameter, javax.servlet.http package, handling http request and response with HTTPGET and HTTPPOST, cookies,session tracking. JSP : Introduction, Types of JSP tags, Application using JSP and Servlet.

JavaBeans : Advantages of Beans, JDK, JAR files, Introspection, Developing Beans using JDK.

### Books:

1. Complete Reference by Herbert Schildt (TMH)
2. Programming with Java By C Muthu (McGraw Hill)
3. Black Book on java.

## **Paper III : Digital Electronics and Microprocessor**

**Hours/Week : 4**

**Credits : 4**

### **Unit-1 :**

Number System and Data Representation

Number System : Binary, Octal, Decimal and Hexadecimal number system and their inter conversion. Binary Codes : BCD, Excess3 , Parity, Gray, ASCII, EBCDIC codes and their advantages and disadvantages. Data Representation : Positive , negative ,maximum and minimum number representation (related to 8 bit number), real number representation, underflow, overflow , range and accuracy. Binary Arithmetic : Binary addition, decimal subtraction using 9's and 10's compliment, binary subtraction using 1's and 2's compliment, multiplication and division. Logic gates: Truth table, properties and symbolic representation of NOT, AND, OR, NOR , NAND, EXOR, EXNOR gates. NOR and NAND gates as a universal gates .

### **Unit-2 :**

Boolean Algebra: Laws and Identities of Boolean algebra, DeMorgan's Theorem , use of Boolean Algebra for simplification of logic expression, K-Map for 2,3,4 variables, simplification of SOP and POS logic expression using K-Map.

Combinational circuits: Half adder, Full Adder, Parallel adder, Half subtractor, Full Subtractor, 4-bit binary adder subtractor, Multiplexer, Demultiplexer, Decoder, Encoder, Parity detector.

### **Unit 3 :**

Sequential Circuits : Flip-Flops : Construction and working of RSFF, JKRSFF, DFF, TFF, JKFF, and JKMSFF . Counters : Construction and working of asynchronous, synchronous, up-down counter, shift registers and their types, Ring counter, Johnson counter with their time diagram.

### **Unit-4 :**

Architecture of 8086 and Assembly Language Programming

Block diagram of 8086, Pin diagram of 8086, Addressing modes, Instruction set: Data transfer, Arithmetic, Logical, String manipulations, Control Transfer, Unconditional branch, Conditional branch, Flag, Processor control. Assembler directives and operators, simple assembly programs.

### **Books:**

- 1.Digital Electronics by Gothman(PHI)
- 2.Digital and analogue technique by Navaneeth, Kale and Gokhale
- 3.Fundamental of Micropocessor by B Ram
- 4.Microcomputers Systems: The 8086/8088 family by Liu. Gibson
5. Modern Digital Electronics By Jain (TMH)

## **Paper IV : Advanced DBMS and Administration**

**Hours/Week : 4**

**Credits : 4**

### **Unit-1 :**

Relational Database design: Functional dependencies, and Normalization Normal forms based on primary keys (1 NF, 2 NF, 3 NF, BCNF, 4 NF, 5 NF) Loss less joins and dependency preserving decomposition Query Processing: Query Processing Stages, Query Interpretation, Equivalence of Expressions, Query Resource Utilization, Query Execution Statistics, Query Execution Plan, Estimation of Query Processing Cost, Table Scan, Sample Index Access, Fill Factor, Multiple Index Access, Methods for Joining Tables (Nested Loop, Merge Join, Hybrid Join, Multiple Join) Structure of a Query Optimizer

### **Unit-2 :**

Transaction Processing & Concurrency Control: Concept and definition of transaction, ACID properties, serializability, Prioritization, states of transaction, Types of failure, desirable properties of transaction schedules and recoverability, serial usability of schedules, levels of transaction consistency, deadlocks, long duration transactions, transaction performance, transaction processing as implemented in contemporary database, management system. Concurrency Control, locking techniques, techniques based on time-stamp ordering, multiple granularity. Crash Recovery: failure classification, recovery concepts, database backup, recovery concepts based on deferred update and on immediate update. Shadow paging, check points, on-line backup during database updates, crash recovery techniques.

Client/Server database: Evolution of client concept, Client/Server environment, characterization of Client/Server computing. Functions of clients server , application partitioning, the two-layer and three-layer architectures, communication between clients and servers.

### **Unit-3 :**

Oracle Database Architecture and Administration: Oracle database architecture, Design, Creation, Migration and Management of Oracle Databases and related database schemes, Data Dictionary views and standard package Maintaining the control, Redo Log files, Managing Tablespace and Data Files, Storage structure and relationships, Managing rollback segment, Managing tables, Indexes, Managing data Integrity, Managing password security and resources, Managing users, Privileges, roles.

Oracle Backup and Recovery Strategies: Backup and recovery considerations, Oracle recovery structure and processes, Oracle backup and recovery configuration, Physical backup, Complete recovery of an Oracle database, Incomplete recovery of an Oracle database with Archiving, Oracle Export / Import utilities, Oracle standby database.

### **Unit-4 :**

Oracle Tuning and Troubleshooting: Oracle performance tuning methodology, Oracle alert and trace files, Tuning the shared pool, Buffer Cache, Redo Log buffer, Database configuration and I/O issues, Using Oracle Blocks efficiently, Optimizing sort operations, Rollback segment tuning, Monitoring and detecting lock contention, SQL issues and tuning considerations for different application. Integrity, Security: Need for Database Integrity, Integrity Constraints, Non-Procedural and Procedural Integrity Constraints Specifications in SQL, Introduction to Database Security issues, Authorization and use.

**Books :**

1. Fundamental of Database Systems by R. Elmasri; S. Navate; Benjamin Cummings;
2. Introduction to database systems by C. J .Date
3. Database system concept by Korth
4. DBA Handbook oracle press by Loney

**Reference Books:**

1. Principles of Database Management by James Martin
2. Relational database design for Micro computers Application by Prentice Hall (Jackson)
3. Database Management Systems by Bipin Desai

**M.Sc. Part I**  
**Semester -2**

**Paper I : Windows Programming using VC++**

**Hours/Week : 4**

**Credits : 4**

**Unit-1 :**

Windows, Visual C++, Application Frameworks Fundamentals and MFC Libraries View Class. Introduction, MFC, ATL and WFC, Windows Programming Model, Components, Application Framework, MFC Library, Event Handling, Mapping Modes and Scrolling Views, Graphic Device Interface, Colors and Fonts, Modal Dialog and Windows Common Control, Modeless Dialog and Windows Common Dialog, ActiveX Controls and Internet Explorer Common Controls, Win32 Memory Management, Bitmaps, Message Processing and Multithreaded Programming.

**Unit-2 :**

Document View Architecture : Menus, Keyboard Accelerators, Rich Edit Control and Property Sheets, Tool bar and Status Bars, Reusable Frame Window Base Class, Separating the Documents from its View, Reading and Writing Documents- SDI applications, MDI applications, Printing and Print Preview, Splitter Windows and Multiple Views, Context-Sensitive Help, DLL's, MFC Programs without Documents or View Classes

**Unit-3 :**

Active X: COM, Automation and OLE : Component Object Model, Automation, Uniform Data Transfer- Clipboard Transfer and OLE, Drag and Drop, Structured Storage, OLE Embedded Components and Containers, Introducing the Active Template Library, ATL and ActiveX Controls.

**Unit-4 :**

Database Management: Database Management with Microsoft ODBC, Database Management with Microsoft Data Access Objects, OLE DB Templates.

Programming for the Internet: TCP/IP, Winsock, WinInet, Programming the Microsoft Internet Information Server, ActiveX document Servers and the Internet, Introducing the Dynamic HTML, Visual C++ for Windows CE.

**Books :**

1. Programming Microsoft Visual C++ by D. J. Kruglilski, G Shepherd and Scot Wingo  
Publication : Microsoft Press Fifth Edition.

**Reference Books:**

1. Visual C++ 6 From The Ground Up: Mueller: TMH Publication
2. VC++ 6 The Complete Reference: Pappas, TMH Publication

## **Paper II : Theory of Computation and Compiler Construction**

**Hours/Week : 4**

**Credits : 4**

### **Unit-1 :**

Finite Automation and Regular Expression : Finite State systems, Basic Definitions, Non - deterministic finite Automata, Finite Automata with moves, Regular Expressions, Two way finite automata, Finite automata with output, Application on Finite Automata.

Properties of Regular Sets : The pumping lemma for Regular Sets, Close properties of Regular sets, Decision Algorithms for Regular Sets.

Context Free Grammars : Motivation and Introduction, Context Free Grammar, Derivation Tree, Simplification of context Free Grammars, Chomsky Normal form, Greibach normal form, The existence of inherently ambiguous context free languages.

Properties of Context free languages : The pumping lemma for CFL's , Closure properties of CFL's, Decision Algorithm for CFL's

### **Unit-2 :**

Push Down Automata : Informal description, Definitions, Push – Down Automata & Context free languages.

Turing Machine : Introduction, The Turing Machine Model, Computable languages and functions , Techniques Turing Machine construction, Modification of Turing Machines, Church's Hypothesis, Turing Machine as enumerators, Restricted Turing Machine equivalent to the basic model. Undecidability : Problems, properties of recursive and recursively enumerable problem, Turing Machine and undecidable problem, Rice theorem, Tool for proving CFL undecidable, Greibach's Theorem.

The Chomsky : Regular Grammars, Unrestricted Grammars, Context – Sensitive languages, Relation between classes of languages.

### **Unit-3 :**

Introduction to Compilers :

Compilers and translators, need, the structure of a compiler, Lexical Analysis, Syntax analysis, Intermediate code Generation, Optimization, Code Generation, Book keeping, Error Handling, Compiler writing tools. Basic parsing Techniques: Parsers, Shift-reduce parsing, Operator precedence parsing, Top-down parsing, predictive parsers, automatic construction of efficient parsers : LR parsers the canonical collection of LF (O) items, constructing SLR parsing tables, constructing LALR parsing tables, Ambiguous grammar.

### **Unit-4 :**

Syntax directed translation : syntax directed translation schemes, implementation, intermediate code, postfix notation, parse tree and syntax trees, tree- address code, quadruple, triple, translation of Symbol Table: Data Structure, Representation of Scope Information,

Code Optimization: The principal source optimization, Loop optimization, The DAG Representation of basic blocks, Value number and algebraic laws, Global data-flow analysis.

Code Generation : Object Programmers Problems in code generation, A machine model, a simple code generator, Register Allocation and assignment, Code Generation from DAG's Peephole Optimization.

**Books :**

1. Introduction to Automata Theory, Languages and Computation: John E. Hopcroft & Jeffrey D. Ullman.
2. Compilers Principles, Techniques and Tools Aho, Ullman, Ravi Sethi, Pearson Education.
3. Theory of Computer Science : E. V. Krishnamoorthy.
4. Theory of computer Science : K. L. P. Mishra.

**Reference Books:**

1. D. I. A. Cohen : Introduction to Computer Theory (JW)
2. H. R. Lewis & C. H. Papadimitriou : Elements of Theory Of Computation (PHI)
3. J. Carroll and D. Long : Theory of Finite Automata (PHI)
4. M. Davis & Weyukur : Computability, Complexity & Languages.
5. M. Machtey & P. R. Young : An introduction to General Theory of Algorithm ( Elsevier).
6. Zvi Lohavi : Switching and Finite Automata Theory (TMH).

## **Paper III : Computer Architecture and Organization**

**Hours/Week : 4**

**Credits : 4**

### **Unit-1 :**

Principle of computer design : Software, hardware interaction, layers in computer architecture, central processing and machine language instruction, addressing modes, instruction types, instruction set selection, instruction and execution cycle.

### **Unit-2 :**

Control Unit : Data path and control path design, microprogramming v/s hardwired control, pipelining in CPU design, RISC v/s CISC, superscalar processors.

### **Unit-3 :**

Memory subsystem : Storage technologies, memory array organization, memory hierarchy, interleaving , cache memory and virtual memory including architectural aids to implement these.

### **Unit-4 :**

Input/ Output Processing : Bus Interface, Data transfer techniques, I/O interrupts and channels,. Performance evaluation : SPECmarks , Transaction Processing Benchmarks.

### **Books :**

1. Computer Architecture and Organization by Tenenbaum
2. Computer Architecture and Organization by J. P. Hayes.
3. Parallel Processing by Hwang
4. Computer Organization by Hamacher, Vranesic, Zaky (TMH)

## Paper IV : Computer Graphics

Hours/Week : 4

Credits : 4

### Unit-1 :

Introduction of computer Graphics and its applications, Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics functions.

### Unit-2 :

Line drawing algorithms, DDA, Bresenham's, Circle generating, Mid-point circle algorithm, Ellipse generating, Polygon, Scan-line polygon fill, Boundary fill.

### Unit-3 :

Basic transformation's, Translation, Rotation, Scaling, Matrix representation's & homogeneous co-ordinates, Composite transformation's, Reflection, Two dimensional viewing, Two dimensional clipping, Line, Polygon, Curve, Text. 3D-transformation, Projection, Viewing, Clipping.

Spline representation, Cubic spline, Bezier curve, Bezier surfaces, Beta spline, B-spline surfaces, B-spline curve, Hidden surfaces, Hidden lines, Z-buffer.

### Unit-4 :

Fractal's geometry Fractal generation procedure, Classification of Fractal, Fractal dimension, Fractal construction methods. Color models, XYZ, RGB, YIQ, CMY & HSV, Shading algorithms, Shading model, Illumination model, Gouraud shading, Phong shading.

### Books :

1. Computer Graphics by M. Pauline Baker, Donald Hearn, 2<sup>nd</sup> Edition PHI.
2. Mathematical Element for Computer Graphics By. David F. Roger., J. Alan Adams, 2<sup>nd</sup> Edition, Tata McGHill.

### Reference Books:

1. Principles of Interactive Computer Graphics By. William. M. Newmann. 2<sup>nd</sup> Edition Mc. Graw Hill.
2. Procedural Element for Computer Graphics By. David F. Roger. Mc. Graw Hill.
3. Computer Graphics By A.P. Godse, 2<sup>nd</sup> Editio TPPublication,
4. Computer Graphics By V.K. Pachghare, 2<sup>nd</sup> Edition, Laxmi Publication
5. Computer Graphics By Apurva Desai (PHI)

**M.Sc. Final  
Semester -3  
Paper I : Data Communication and Network**

**Hours/Week : 4  
Credits : 4**

**Unit-1 :**

Introduction: Network structure and architectures and services OSI reference model.

The Physical Layer: theoretical basis for data communication, transmission media. Analog Transmission, Digital Transmission, Transmission and Switching, ISDN.

The Data Link Layer: Design issues, Error detection and correction, Elementary data link protocols, sliding window protocol, protocols performance, protocols specification and verification. Examples of the Data link layer.

Network Layer: Design issues, routing algorithms, Congestion control algorithms, Internet working, Examples of the network layer.

**Unit-2 :**

The Transport Layer: Design issues, Connection Management.

The session layer: Design issues and remote procedure call.

The Presentation Layer: Design issues, data compression techniques, cryptography.

The Application Layer: Design issues, file transfer, access and management, virtual terminals.

**Unit-3 :**

Network Security Fundamentals: Introduction, security Vulnerabilities and Threats, Classification of Security Services.

Cryptography: Encryption principles, Conventional Encryption DES, IDEA, Algorithms, CBC, Location of Encryption Devices key Distribution.

**Unit-4 :**

Message Digests and Checksums, Message Authentication, Message Digests, Hash Functions and SHA, CRCs. Public key Systems: RSA Diffie-Hellman, DSS, Key Management.

Intruders: Intrusion Techniques, Intrusion Detection, Authentication, Password- Based Authentication, Address- Based Authentication, Certificates, Authentication Services, Email Security, Firewalls, Design Principles, Packet Filtering, Access Control, Trusted Systems, Monitoring and Management.

**Books :**

1. Computer Networks – Andrew S Tanenbum (PHI)
2. Network Security and Essentials: Application and standers
3. Willam Stalling – Pearson Education.
4. Cryptography and network security
5. Willam Stalling – Pearson Education.

**Reference Books:**

1. Internet Security: Timspeed, Juanita Ellis, Digital Press Publication
2. Internet Security: Jan L. Harington, Morgan Kaufmann Publication
3. Firewall Network System: John R. Vacca, Scott R. Ellis, Digital Press
4. Network Algorithm, George Varghese, Morgan Kaufmann Publication
5. TCP/IP Addressing: Buck Graham, Morgan Kaufmann Publication
6. Data Communication and Networking: Behrouz A. Forouzan, TMH.

## Paper II : Software Engineering

Hours/Week : 4

Credits : 4

### Unit-1 :

Introduction to Software Engineering : The evolving role of software, Changing Nature of Software, Software myths.

A Generic view of process : Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models.

Process models : The waterfall model, Incremental process models, Evolutionary process models, The Unified process. Software Requirements : Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.

### Unit-2 :

Requirements engineering process : Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models : Context Models, Behavioral models, Data models, Object models, structured methods. Modeling with UML .

Design Engineering : Design process and Design quality, Design concepts, the design model.

Creating an architectural design : Software architecture, Data design, Architectural styles and patterns, Architectural Design.

### Unit-3 :

Object-Oriented Design : Objects and object classes, An Object-Oriented design process, Design evolution. Performing User interface design : Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.

Testing Strategies : A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics : Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

### Unit-4 :

Metrics for Process and Products : Software Measurement, Metrics for software quality.

Risk management : Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

Quality Management : Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

### Books :

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition. McGrawHill International Edition.

2. Software Engineering- Sommerville, 7th edition, Pearson education.

### Reference Books:

1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers

2. Software Engineering an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.

3. Systems Analysis and Design- Shely Cashman Rosenblatt, Thomson Publications.

4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill.

## Paper III : Neural Network

Hours/Week : 4

Credits : 4

### Unit-1 :

Introduction: Feedforward Neural Networks: Artificial Neurons, Neural Networks and Architectures: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Network Geometry of Binary Threshold Neurons and Their Network: Patterns Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are pattern Dichotomizes, Non-linearly separable Problems, Capacity of a simple Threshold Logic Neuron, Revisiting the XOR Problem, Multilayer Networks.

### Unit-2 :

Supervised Learning I: Perceptrons and LMS: Learning and Memory, From Synapses to Behaviour: The Case of Aplysia, Learning Algorithms, Error Correction and Gradient Descent Rules, The Learning Objective for TLNs, Pattern space and Weight Space, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable Sets, Handling Linearly Non-Separable sets,  $\alpha$ -Least Mean Square Learning, MSE Error Surface and its Geometry, Steepest Descent Search with Exact Gradient Information,  $\mu$ -LMS: Approximate Gradient Descent, Application of LMS to Noise Cancellation

### Unit-3 :

Supervised Learning II: Backpropagation and Beyond: Multilayered Network Architectures, Backpropagation Learning Algorithm, Structure Growing Algorithms, Fast Relatives of Backpropagation, Universal Function Approximation and Neural Networks, Applications of Feedforward Neural Networks, Reinforcement Learning

### Unit-4 :

Neural Networks: A Statistical Pattern Recognition Perspective: Introduction, Bayes Theorem, Classification Decisions With Bayes Theorem, Probabilistic Interpretation Of A Neuron Discriminant Function, Interpreting Neuron Signals As Probabilities, Multilayered Networks, Error Functions And Posterior Probabilities, Error Functions For Classification Problems  
Generalization: Support Vector Machines and Radial Basis Function Networks: Learning from Examples and Generalization, Statistical Learning Theory Briefer, Support Vector Machines, Radial Basis Function Networks, Regularization Theory Route to RRBFNs, Generalized Radial Basis Function Network, Learning In RRBFNs, Image Classification Application, Other Models for Valid Generalization

### Books :

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, Tata Mcgraw Hill

### Reference Books:

1. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2<sup>nd</sup> edition 2004
2. Artificial neural networks - B.Yegnanarayana, Prentice Hall of India P Ltd 2005.
3. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
4. Neural networks James A Freeman David M S kapura, Pearson education 2004.
5. C++ Neural Network and Fuzzy Logic 2nd Edition, Valluru B. Rao, Hayagriva V. Rao, Henry Holt and Co.

## **Paper IV :**

### **Elective-1**

#### **Paper 1.1 : Mobile Computing**

**Hours/Week : 4**

**Credits : 4**

##### **Unit-1 :**

Mobile Communications: An Overview: Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination, Mobility Management, Security Mobile Devices and Systems: Mobile Phones, Digital Music Players, Handheld Pocket Computers, Handheld Devices: Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems GSM and Similar Architectures: GSM-Services and System, Architecture, Radio Interfaces, Protocols, Localization, Calling Handover, Security, New Data Services, General Packet Radio Service, High-speed Circuit Switched Data, DECT

##### **Unit-2 :**

Wireless Medium Access Control and CDMA based Communication: Medium Access Control, Introduction to CDMA-based Systems, Spread Spectrum in CDMA Systems, Coding Methods in CDMA, IS-95 cdma One System, IMT- 2000, i - m o d e , O F D M , Mobile IP Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation Route Optimization, Dynamic Host Configuration Protocol, Mobile Transport Layer, Conventional TCP/IP Transport, Layer Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Methods of TCP-layer Transmission for Mobile Networks, TCP Over 2.5G/3G Mobile Networks

##### **Unit-3 :**

Databases: Database Hoarding Techniques, Data Caching, Client-Server Computing and Adaptation, Transactional Models, Query Processing, Data Recovery Process, Issues relating to Quality of Service, Data Dissemination and Broadcasting Systems: Communication Asymmetry, Classification of Data-Delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing Techniques, Digital Audio Broadcasting, Digital Video Broadcasting, Data Synchronization in Mobile Computing Systems: Synchronization, Synchronization Software for Mobile Devices, Synchronization Protocols, SyncML Synchronization Language for Mobile Computing, Sync4J (Funambol), Synchronized Multimedia ,Markup Language (SMIL)

##### **Unit-4 :**

Mobile Devices Server and Management: Mobile Agent, Application Server, Gateways, Portals, Service Discovery, Device Management, Mobile File Systems, Security, Mobile Adhoc and Sensor Networks: Introduction to Mobile Ad-hoc Network, MANET, Wireless Sensor Networks, Applications Wireless LAN, Mobile Internet Connectivity, and Personal Area Network: Wireless LAN (WiFi) Architecture and Protocol Layers, WAP 1.1 and WAP 2.0, Architectures, XHTML-MP (Extensible Hypertext Markup Language Mobile Profile), Bluetooth-enabled Devices Network, Layers in Bluetooth Protocol, Security in Bluetooth Protocol, IrDA, ZigBee Mobile Application Languages XML, Java, J2ME, and Java Card: Introduction, XML, JAVA, Java 2 Micro Edition (J2ME), JavaCard, Mobile Operating Systems : Operating System PalmOS, Windows CE, Symbian OS, Linux for Mobile Devices 530

**Books :**

1. Mobile Computing, Raj Kamal, Oxford University Press

**Reference Books:**

1. Mobile Communications Jochen Schiller, Addison-Wesley.
2. Handbook of Wireless Networks and Mobile Computing, Stojmenovic and Cacute, Wiley,
3. Mobile Computing Principles: Designing and Developing Mobile
4. Applications with UML and XML, Reza Behravanfar, Cambridge University Press,

## **Paper IV :**

### **Elective-1**

#### **Paper 1.2 : Multimedia Technologies**

**Hours/Week : 4**

**Credits : 4**

##### **Unit-1 :**

Fundamental concepts in Text and Image: Multimedia and hypermedia, world wide web, overview of multimedia software tools. Graphics and image data representation graphics/image data types, file formats, Color in image and video: color science, color models in images, color models in video. Fundamental concepts in video and digital audio: Types of video signals, analog video, digital video, digitization of sound, MIDI, quantization and transmission of audio.

##### **Unit-2 :**

Action Script I : ActionScript Features, Object-Oriented ActionScript, Datatypes and Type Checking, Classes, Authoring an ActionScript Class Action Script II : Inheritance, Authoring an ActionScript 2.0 Subclass, Interfaces, Packages, Exceptions.

##### **Unit-3 :**

Application Development : An OOP Application Frame work, Using Components with ActionScript MovieClip Subclasses.

Multimedia data compression: Lossless compression algorithm: Run-Length Coding, Variable Length Coding, Dictionary Based Coding, Arithmetic Coding, Lossless Image Compression, Lossy compression algorithm: Quantization, Transform Coding, Wavelet-Based Coding, Embedded Zerotree of Wavelet Coefficients Set Partitioning in Hierarchical Trees (SPIHT).

##### **Unit-4 :**

Basic Video Compression Techniques: Introduction to video compression, video compression based on motion compensation, search for motion vectors, MPEG, Basic Audio Compression Techniques.

Multimedia Networks: Basics of Multimedia Networks, Multimedia Network Communications and Applications : Quality of Multimedia Data Transmission, Multimedia over IP, Multimedia over ATM Networks, Transport of MPEG-4, Media-on-Demand(MOD).

##### **Books :**

1. Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew PHI/Pearson Education.
2. Essentials ActionScript 2.0, Colin Moock, SPD O,REILLY.

##### **Reference Books:**

1. Digital Multimedia, Nigel chapman and jenny chapman, Wiley-Dreamtech
2. Macromedia Flash MX Professional 2004 Unleashed, Pearson.
3. Multimedia and communications Technology, Steve Heath, Elsevier(Focal Press).
4. Multimedia Applications, Steinmetz, Nahrstedt, Springer.
5. Multimedia Basics by Weixel Thomson.
6. Multimedia Technology and Applications, David Hilman , Galgotia.

## **Paper IV : Elective-1**

### **Paper 1.3 : ASP.Net**

**Hours/Week : 4**

**Credits : 4**

#### **Unit-1 :**

ASP.NET programming model: Introduction, event driven programming over http, http protocol, structure of ASP.NET page, ASP.NET component model, ASP.NET Provider model, Anatomy of ASP.Net Page: Invoking page, Page class, Page Life cycle.

ASP.NET Core Server controls: Generalities of Server Controls, Properties, events and methods of Control class, HTML controls: Generalities of HTML controls, HTML Containers, HTML input controls.

#### **Unit-2 :**

Web controls: Generalities of Web Control, core web control, misc web control, Validation controls: Generalities of validation controls, Gallery of controls, Programming with Web forms; HtmlFrom Class, Multiple forms, cross page postings, Page errors, Page Personalization.

Ritch Page Composition: Working with master page, working with themes, working with wizards, ADO.NET data Providers, Connecting to data sources: connection strings, connection pooling, Executing commands: ADO Data Readers, Data Adapters, working with transactions, procedures etc. Data container objects: Data sets, Data tables, Data Relations, Data binding models: expressions and components.

#### **Unit-3 :**

Creating bindable grid of data: DataGrid Control, GridView control, Managing list of records: ListView control and Managing views of records: DetailView Control, FormView Control, Initialization of Application: HttpApplicationClass, Application module, methods and events of HttpApplication Class, The global.asax file, HttpContext Class, Server Object, HttpResponse Object, HttpRequest Object.

#### **Unit-4 :**

ASP.NET state management: Application state, Session State: working with session state, customizing session state, view state of page. ASP.NET caching: Caching Application data, the Cache Class, ASP.NET Security: Using Form authentication, membership and role management API, Security related controls, AJAX Enabled web services: Web services as application specific services, remote call via web services,

#### **Books :**

1. Programming with Microsoft ASP.NET 3.5 by Dino Esposito, Microsoft Press
2. Programming with Microsoft ASP.NET 4.0 by Microsoft Press
3. The Complete Reference ASP.NET by MacDonald(TM)

**M.Sc. Final  
Semester -4**

**Paper I : Data Mining**

**Hours/Week : 4**

**Credits : 4**

**Unit-1 :**

Introduction to Data Mining: Why Mine Data? Commercial Viewpoint, Scientific Viewpoint Motivation, Definitions, Origins of Data Mining, Data Mining Tasks, Classification, Clustering, Association Rule Discovery, Sequential Pattern Discovery, Regression, Challenges of Data Mining, Data Mining-Data: What is Data? Attribute Values, Measurement of Length, Types and Properties of Attributes, Discrete and Continuous Attributes, Types of data sets, Data Quality, Data Preprocessing, Aggregation, Sampling, Dimensionality Reduction, Feature subset selection, Feature creation, Discretization and Binarization, Attribute Transformation, Density.

**Unit-2 :**

Data Mining: Exploring Data: Data Exploration Techniques, Summary Statistics, Frequency and Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, Visualization, Representation, Arrangement, Selection, Visualization Techniques: Histograms, , Box Plots, Scatter Plots, Contour Plots, Matrix Plots, Parallel Coordinates, Other Visualization Techniques, OLAP : OLAP Operations, Data Mining Classification: Basic Concepts, Decision Trees, and Model Evaluation: Classification: Definition, Classification Techniques, Tree Induction, Measures of Node Impurity, Practical Issues of Classification, ROC curve, Confidence Interval for Accuracy, Comparing Performance of Two Models, Comparing Performance of Two Algorithms.

**Unit-3 :**

Data Mining Classification: Alternative Techniques: Rule-Based Classifier, Rule Ordering Schemes, Building Classification Rules, Instance-Based Classifiers, Nearest Neighbor Classifiers, Bayes Classifier, Naive Bayes Classifier, Artificial Neural Networks (ANN), Support Vector Machines. Data Mining Association Analysis: Basic Concepts and Algorithms: Association Rule Mining, Frequent Itemset Generation, Association Rule Discovery : Hash tree, Factors Affecting Complexity, Maximal Frequent Horrible Closed Itemset, Alternative Methods for Frequent Itemset Generation, FPgrowth Algorithm, Tree Projection, Rule Generation, Pattern Evaluation, Statistical Independence, Properties of A Good Measure, Support-based Pruning, Subjective Interestingness Measure.

**Unit-4 :**

Data Mining Cluster Analysis: Basic Concepts and Algorithms: Applications of Cluster Analysis, Types of Clusters, Clustering Algorithms: 'K-means and its variants, Hierarchical clustering, Density based clustering. Graph-Based Clustering, Limitations of Current Merging Schemes, Characteristics of Spatial Data Sets, Shared Near Neighbor Approach, ROCK (RObust Clustering using linKs), Jarvis Patrick Clustering, SNN Clustering Algorithm, Data Mining Anomaly Detection: Anomaly jOutlier Detection, Importance, Anomaly Detection Schemes, Density-based: LOF approach

**Books :**

1. Introduction to Data Mining by Tan, Steinbach, Kumar.
2. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Morgan Kaufmann

**Reference Books:**

1. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten and Eibe Frank, Morgan Kaufmann, 2nd Edition (2005).
2. Principles of Data Mining: David Hand, Heikki Mannila & Padhraic Smyth, PHP Publication.

## **Paper II : Artificial Intelligence & Expert System**

**Hours/Week : 4**

**Credits : 4**

### **Unit-1 :**

AI problems, AI Techniques, Tic-tac-toe, Question Answering, Problem as a state space search, A water jug problem, production system, Control strategies, Heuristic Search, Problem Characteristics, Production system characteristics, Design of search programs

AI Search techniques :- Depth-first, Breadth-first search, Generate-and-test, Hill climbing, Best-first search, Constraint satisfaction, Mean-ends-analysis, A\* Algorithm, AO\* algorithm.

### **Unit-2 :**

Knowledge Representation:- Representations and mappings, Knowledge Representations, Issues in Knowledge Representation, Predicate Logic:- Representing Instance and Isa Relationships, Computable Functions and predicates, Resolution, Natural Deduction, Logic programming, Forward versus Backward Reasoning, Matching, Control knowledge, Expert System.

### **Unit-3 :**

Games playing : Minimax search procedure , adding alpha-beta cutoffs, additional refinements, Planning :- Component of a planning system, Goal task planning, Nonlinear planning, Hierarchical Planning.

### **Unit-4 :**

Understanding, Understanding as Constraint satisfaction, Natural Language Processing, Syntactic Processing, Unification grammars, Semantic Analysis, Introduction to pattern recognition, Parallel and Distributed AI, Psychological Modeling, Distributed Reasoning Systems,

### **Books :**

1. Artificial Intelligence by Elaine Rich, Mcgrawhill Inc.
2. Artificial Intelligence and Expert Systems – Jankiraman, Sarukes (M)

### **Reference Books:**

1. Expert System : Theory and Practice- Ermine (PHI)
2. Lisp Programming – Rajeo Sangal – (TMH)
3. Rule based Expert System – M.Sasikumar (Narosa)
4. Artificial intelligence – Russell-Pearson- Ist Text book.
5. Principles of AI- Nils Nilson
6. A.I. by R.J.Winston - Pearson
7. ES : Theory and Practice- Ermine – PHI.
8. Int. ti Expert System – Jackson – Pearson.

## Paper III : Design and Analysis of Algorithm

Hours/Week : 4

Credits : 4

### Unit-1 :

Elementary Algorithmics: Introduction- Problems and Instances- The Efficiency of algorithms- Average and worst case Analysis. Asymptotic Notation: A notation for the order of – Other asymptotic notation- Conditional asymptotic notation- Asymptotic notation with several parameters- Operations on asymptotic notation.

Analysis of Algorithms: Introduction- Analyzing control structures- Average case analysis- Amortized Analysis- Solving recurrences.

### Unit-2 :

Greedy Algorithms: Making change- General Characteristics of Greedy algorithms- Minimum spanning trees and shortest paths- Knapsack Problems- Scheduling.

Divide and Conquer: Introduction- Multiplying large numbers- The general template- binary search- sorting- Finding the median- Matrix multiplication- Introduction to cryptography.

### Unit-3 :

Dynamic Programming: The Principle of Optimality- making change the knapsack problem- shortest paths- Chained matrix multiplication- approaches using recursion- Memory functions.

### Unit-4 :

Back tracking & Branch Bound: Traversing trees- Depth first search of directed and undirected graph- Breadth first search- Back tracking- Branch and bound- The minimax principle, Introduction to NP- Completeness; Classes P and NP- Polynomial reductions- NP- Complete Problems NP- Hard problems- Non- Deterministic algorithms.

### Books :

1. Fundamentals of Algorithms - Gilles Brassard & Paul Bratley. Prentice-Hall (India)Ltd.

### Reference Books:

1. Fundamentals of Computer Algorithms by Ellis Horowitz & Sartaj Sahani. Galgotia Publication.
2. Computer Algorithms: Introduction to Design & Analysis. Sara Baase & Alien Van Gelder. Addison Wesley Publishing Company.

**Paper IV :**  
**Elective-2**  
**Paper 2.1 : Embedded System**

**Hours/Week : 4**  
**Credits : 4**

**Unit-1 :**

Introduction to Embedded Systems: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software in a System, Examples of Embedded Systems, Embedded System-on-chip (Soc) and Use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formalization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer 8051 and Advanced Processor Architectures, Memory Organization and Realworld Interfacing:

8051 architecture, Real World Interfacing, Introduction to Advanced Architectures, Processor and Memory Organization, Instruction-Level Parallelism, Performance Metrics, Memory-Types, Memory-Maps and Addresses, Processor Selection, Memory Selection, Devices and Communication Buses for Devices Network :Types and Examples, Serial Communication Devices, Parallel Device Ports, Sophisticated Interfacing Features in Device Ports, Wireless Devices, Timer and Counting Devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Serial Bus Communication Protocols, Parallel Bus Device Protocols-Parallel Communication Network Using ISA, PCI, PCI-X and Advanced Buses, Internet Enabled Systems-Network Protocols, Wireless and Mobile System Protocols

**Unit-2 :**

Device Drivers and Interrupts Service Mechanism: Programmed-I/O Busy-wait Approach without Interrupt Service Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processors Interrupt Service Mechanism from Context-Saving Angle, Direct Memory Access, Device Driver Programming,

Programming Concepts and Embedded Programming in C, C++ and Java: Software Programming in Assembly Language (ALP) and in High-Level Language 'C' 235 , C Program Elements: Header and Source Files and Preprocessor Directives, Program Elements:

Macros and Functions, Program Elements: Data Types, Data Structures, Modifiers, Statements, Loops and Pointers, Object-Oriented Programming, Embedded Programming in C++, Embedded Programming in Java,

Program Modeling Concepts: Program Models, DFG Models, State Machine Programming

Models for Event-controlled Program Flow, Modeling of Multiprocessor Systems, UML Modelling

**Unit-3 :**

Interprocess Communication and Synchronization of Processes, Threads and Tasks: Multiple Processes in an Application, Multiple Threads in an Application, Tasks, Task States, Task and Data, Clearcut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, Shared Data, Interprocess Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions,

Real Time Operating Systems : OS Services, Process Management, Timer Functions, Event Functions, Memory Management, Device, File and I/O Subsystems Management, Interrupt Routines in RTOS Environment and Handling of Interrupt Source Calls, Real-time Operating Systems, Basic Design Using an RTOS, Rtos Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Issues,

#### **Unit-4 :**

Real time Operating System ProgrammingI:

MicroDOS-II and VxWorks, Basic Functions and Types of RTOSes, RTOS mCOS-II, RTOS VxWorks,

Realtime Operating System ProgrammingII:

Windows CE, OSEK and Real-time Linux Functions, Windows CE, OSEK, Linux 2.6.x and RTLinux,

Design Examples and Case Studies of Program Modeling and Programming with RTOS I: Case Study of Embedded System Design and Coding for an Automatic, Chocolate Vending Machine (ACYM) Using Mucos RTOS, Case Study of Digital Camera Hardware and Software Architecture, Case Study of Coding for Sending Application Layer Byte Streams on a TCP/IP Network Using RTOS Vxworks

Design Examples and Case Studies of Program Modeling and Programming with RTOS 2:

Case Study of Communication Between Orchestra Robots, Embedded Systems in Automobile, Case Study of an Embedded System for an Adaptive Cruise Control (ACC) System in a Car, Case Study of an Embedded System for a Smart Card, Case Study of a Mobile Phone Software for Key Inputs,

Embedded Software Development Process and Tools: Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-design,

Testing, Simulation and Debugging Techniques and Tools: Testing on Host Machine: Simulators, Laboratory Tools

#### **Books :**

1. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill

#### **Reference Books:**

1. Embedded System Design” Frank Vahid&Tony Givargis; John Wiley &sons, Inc.
2. Real – Time Systems and software” Alan C. Shaw ; John Wiley &Sons Inc
3. Fundamentals of embedded Software”, Daniel W. Lewis, Pearson
4. Real time Systems”, J. W. S. Liu, Pearson
5. Embedded Realtime System Programming”, S. V. Iyer and P. Gupta, TMH
6. An Embedded System Primer” David E. Simon; Addison-Wesley Pub
7. Embedded System Design” Steve Heath; Butterworth-Heinemann Pub.
8. Embedded System Computer Architecture” Graham Wilson, Butterworth-Heinemann
9. Introduction to Embedded Systems by Shibu K V (TMH)

**Paper IV :**  
**Elective-2**  
**Paper 2.2 : Pattern Recognition**

**Hours/Week : 4**  
**Credits : 4**

**Unit-1 :**

Introduction to Pattern Recognition, Bayesian decision theory: Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, discrete features

**Unit-2 :**

Maximum Likelihood and Bayesian Estimation: Parameter estimation methods, Maximum-Likelihood estimation, Bayesian estimation, Bayesian Parameter Estimation, Gaussian Case, General Theory, Problem of Dimensionality, Accuracy, Dimension, and Training Sample Size, Computational Complexity and Overfitting, Component Analysis and Discriminants, Principal Component Analysis (PCA), Expectation Maximization (EM), Hidden Markov models for sequential pattern classification, First-Order Markov Models, First-Order Hidden Markov Models, Hidden Markov Model Computation, Evaluation, Decoding and Learning.

**Unit-3 :**

Non-parametric: Density estimation, Parzen-window method, Probabilistic Neural Networks (PNNs), K-nearest Neighbour, Estimation and rules, Nearest Neighbour and Fuzzy Classification. Linear Discriminant function based classifiers: Perceptron, Linear Programming Algorithm, Support Vector Machines (SVM)

**Unit-4 :**

Multilayer Neural Network: Feed Forward Classification, Back Propagation Algorithm, Error Surface Stochastic Data: Stochastic search, Boltzmann Learning, Evolutionary method and Genetic Programming. Non-metric methods for pattern classification: Decision trees, Classification and Regression Trees (CART) and other tree methods, String recognition and Rule Based method. Unsupervised learning and clustering : Mixture Densities and Identifiability, Maximum Likelihood estimation, Application Normal Mixture, Unsupervised Bayesian Learning, Data Description and Clustering, Hierarchical Clustering, Graph theory method, Problem of validity, Component analysis

**Books :**

1. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification 2nd Edition", John Wiley, 2007
2. Christopher M. Bishop, "Neural Network for Pattern Recognition", Oxford Ohio Press.

**Reference Books:**

1. E. Gose, R. Johansonbargh, "Pattern Recognition and Image Analysis", PHI
2. Ethen Alpaydin, "Introduction to Machine Learning", PHI
3. SatishKumar, "Neural Network- A Classroom Approach", McGraw Hill.
4. Dr. Rao & Rao, Neural Network & Fuzzy Logic
5. S. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press,
6. C.M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
7. Rajjan Shinghal : Pattern Recognition (TMH)

**Paper IV :**  
**Elective-2**  
**Paper 2.3 : Parallel Computing**

**Hours/Week : 4**  
**Credits : 4**

**Unit-1 :**

Introduction to Parallel Computing: Motivating Parallelism, Scope, Applications, Parallel Programming Platforms: Implicit Parallelism: Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques

**Unit-2 :**

Principles of Parallel Algorithm Design: Preliminaries ,Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Basic Communication operations:One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift , Improving the Speed of Some Communication Operations

**Unit-3 :**

Analytical Modeling of Parallel Programs: Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics, Programming Using the Message Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations , MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators,

**Unit-4 :**

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming, Dense Matrix Algorithms: Matrix- Vector Multiplication, Matrix-Matrix Multiplication, Solving a System of Linear Equations Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort, Other Sorting Algorithms, Graph Algorithms: Minimum spanning tree Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm Search Algorithms for Discrete Optimization Problems: Sequential Search Algorithms, Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms, Dynamic Programming: Overview of Dynamic Programming, Serial Monadic DP Formulations, Monadic DP Formulations, The Longest-Common- Subsequence Problem, Serial Polyadic DP Formulations, Floyd's All-Pairs Shortest-Paths Algorithm, Nonserial Polyadic DP Formulations, The Optimal Matrix-Parentesization Problem, Fast Fourier Transform: The Serial Algorithm, The Binary-Exchange Algorithm, The Transpose Algorithm

**Books :**

1. Introduction to Parallel Computing, Ananth Grama, Pearson Education

**Reference Books:**

1. Fundamental of Paralle Processing, Harry F. Jordan, Gita Alaghband, Pearson Education
2. Parallel Programming, Michael Allen, Barry Wilkinson, Pearson Education