UNIVERSITY OF NORTH BENGAL

SYLLABUS
For

M.Sc. in
Computer Science

(To be implemented from Session 2015-16)

Proposed Structure for Syllabus of Four Semester (Full Time) M.Sc. Programme in Computer Science

Year	Semester	Paper	Paper Type	Periods / Week	Exam. Marks	Continuing Evaluation	
						Sessional	Nature
1st Year	I	CS 11	Theory	3	75	25	Class Test
		CS 12	Theory	3	75	25	Class Test
		CS 13	Theory	3	75	25	Class Test
		CS 11L	Lab-I	6	50	25	Assignment
		CS 12L	Lab-II		25		Design
					300	**100**	
	II	CS 21	Theory	3	75	25	Class Test
		CS 22	Theory	3	75	25	Class Test
		CS 23	Theory	3	75	25	Class Test
		CS 21L	Lab-III	6	50	25	Assignment
		CS 22L	Lab-IV	6	25		Assignment
					300	**100**	
2nd Year	III	CS 31	Theory	3	75	25	Class Test
		CS 32E	Theory	3	75	25	Class Test
		CS 33E	Theory	3	75	25	Class Test
		CS 31L	Lab-V	6	50	25	Assignments
		CS34S	Seminar	6	25		Seminar
					300	**100**	
	IV	CS 41	Theory	3	75	25	Class Test
		CS 42E	Theory	3	75	25	Class Test
		CS 41L	Lab-VI	3	50	25	Assignments
		CS43P	Project	6	75	25	
		CS44V	Grand Viva	6	25		
					300	**100**	

Total Exam Marks	300x4	= 1200
Total Sessional Marks	100x4	= 400
Grand Total		**=1600**

Note: One ‘Period’ is of 1 Hr. duration.

Proposed Paper Structure for the Syllabus of Four Semester (Full Time) M.Sc. Programme in Computer

Year	Semester	Paper	Paper Type	Exam. Marks	Continuing Evaluation (CE)	
					Sessional	**Nature**
1st Year	**I**	CS 11	Data Structures and Algorithms	75	25	Class Test
		CS 12	OOPs using JAVA	75	25	Class Test
		CS 13	Mathematical Foundation in Computer Science	75	25	Class Test
		CS 11L	Data Structure using Java Lab	50	25	Assignment
		CS 12L	Digital Design Lab	25		Design
				300	**100**	
	II	CS 21	Microprocessors and Advance Computer Architecture	75	25	Class Test
		CS 22	Software Engineering	75	25	Class Test
		CS 23E	**Elective 1**	75	25	Class Test
		CS 21L	Microprocessor and Interfacing Lab	50	25	Assignment
		CS 22L	Visual Programming Lab	25		Assignment
				300	**100**	
2nd Year	**III**	CS 31	Internet and Web Technology	75	25	Class Test
		CS 32	Data Communication and Computer Networks	75	25	Class Test
		CS 33E	**Elective 2**	75	25	Class Test
		CS 31L	Web Technology Lab	50	25	Assignments
		CS34S	Seminar	25		Seminar
				300	**100**	
	IV	CS 41	Parallel Computing	75	25	Class Test
		CS 42E	**Elective3**	75	25	Class Test
		CS 41L	Parallel Programming Lab	50	25	Assignments
		CS43P	Project	75	25	Assignments
		CS44V	Grand Viva	25		
		300			**100**	

Total Exam Marks	= 1200
Total Sessional Marks	= 400
Grand Total	**=1600**

List of Electives

CS 23E Electives

E21: Automata Theory & Formal Languages
E22: Principles of Programming Languages
E23: Design and Analysis of Algorithms
E24: Real Time and Embedded Systems

CS 33E Electives

E31: System Software and Compiler Constructions
E32: Computer Graphics
E33: Digital Image Processing and Steganography
E34: Cloud and Grid Computing
E35: Mobile and Pervasive Computing

CS 42E Electives

E41: AI and Expert System
E42: Data Warehousing & Data Mining
E43: Soft Computing
E44: Information Security and Cyber Forensics
E45: Cryptography and Network Security
E46: Software Project Management and SQA

** The allotment of electives depends on the availability of Teachers

Detailed Syllabus of Compulsory Papers

CS 11: Data Structures and Algorithms

Introduction to Data Structures: Introduction to basic and user defined data types and their significance, Data types as data structures, user defined data structures, various well known data structures, Abstract Data Types (ADTs).
Introduction to Algorithm: Flowchart to Algorithm, Definition and properties of Algorithm, Top-down and bottom-up approach to algorithm design, Classification of algorithms, Recursive Algorithms, Algorithm Comparison, Analysis of Algorithm, Frequency count, Time and Space Complexity analysis, Big-OH notation, Estimation of Time complexity in Best, Worst and average cases.
Array: Introduction, Need of Array, Single and Multi dimensional Arrays, Memory Representation, Address calculation using Row and Column major ordering, various operations on arrays, Vectors, Applications of Arrays, Matrix operations, sparse polynomial representation and operations, Advantages and Limitations of Arrays.
Linked Lists: Defining, Singly, Doubly and Circular Linked Lists, Implementing linked lists, Operations on Linked lists with creation, insertion and deletion, searching etc., Polynomial representation and manipulation using Linked Lists
Stacks: Introduction to Stack, Stack as ADT, representation and implementation of stack, Stack Operations, Applications of Stack, Conversion and Evaluation of expressions from one notation to another, Generalizing a Stack and its implementation using Templates
Queues: Introduction to Queue, Queue as ADT, Circular, Priority and D-Queues, representation and implementation of queues, Queue Operations, Applications of Queue, Generalizing a queue and its implementation using Templates
Trees: Introduction to Tree and its properties, Tree as ADTs, Different types of Trees, Tree Representation and implementation, AVL Trees, Threaded Trees, Heaps, Spanning trees, Minimum cost Spanning trees, different tree traversal algorithms i.e. in-order, pre-order, post order, Application of Trees.
Graphs: Introduction to Graph, properties and types of graphs, graph representation and implementations, different graph traversal methods, Kruskals, Prims Algorithms, Finding shortest paths in a digraph
Searching Algorithms: Introduction, importance of searching, sequential & binary search algorithms and their implementation, index search, hashing schemes, Complexity Analysis of different searching algorithms
Sorting Algorithms: Introduction and Importance of sorting, Implementation of selection sort, insertion sort, merge sort, quick sort, radix sort, heap sort, topological sorting, Complexity Analysis of different sorting algorithms

References:

1. Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia, 2nd Edition, 2002.
2. Debasis Samanta, Classic Data Structures, PHI, 2nd Edition
3. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi.
4. S. Lipschutz, Data Structures Mc-Graw Hill International Editions, 1986.
5. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to data structures with Applications, Tata Mc-Graw Hill International Editions, 2nd edition, 1984.
6. A. Michael Berman, Data structures via C++, Oxford University Press, 2002.

7. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, 2002, 2nd edition.
8. M.T. Goodrich, R. Tamassia and D. Mount, Data Structures and Algorithms in C++, John Wiley & Sons, Inc., 2004.
9. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms (2nd ed.), Prentice-Hall of India, 2006
10. M.J. Folk, B. Zoellick and G. Riccardi, File Structures: An Object Oriented Approach With C++ (3rd ed.), Addison- Wesley, 1997.
11. Robert L. Kruse and A.J. Ryba, Data structures and program design in C++, Prentice-Hall, Inc., NJ, 1998.
12. B. Stroupstrup, The C++ Programming Language, Addison Wesley, 2004.
13. D.E.Knuth, Fundamental Algorithms, Vol. I, Addison Wesley, 1997.

CS 12: OOPs using JAVA

Basics of Java: Introduction, History and Features of Java, Internals of Java Program, Difference between JDK,JRE and JVM, Internal Details of JVM, Variable and Data Type, Unicode System, Naming Convention.
OOPS Concepts: Advantage of OOPs, Object and Class, Method Overloading, Constructor, static variable, method and block, this keyword, Inheritance (IS-A), Aggregation and Composition(HAS-A), Method Overriding, Covariant Return Type, super keyword, Instance Initialize block, final keyword, Runtime Polymorphism, static and Dynamic binding, Abstract class and Interface, Downcasting with instance of operator, Package and Access Modifiers, Encapsulation, Object class, Object Cloning, Java Array, Call By Value and Call By Reference, strictfp keyword, Creating API Document
String Handling: Introduction, Immutable String, String Comparison, String Concatenation, Substring , Methods of String class, StringBuffer class, StringBuilder class, Creating Immutable class, toString method, StringTokenizer class,
Exception Handling: Introduction, try and catch block, Multiple catch block, Nested try, finally block, throw keyword, Exception Propagation, throws keyword, Exception Handling with Method Overriding, Custom Exception
Nested Classes: Introduction, Member Inner class, Annonymous Inner class, Local Inner class, static nested class, Nested Interface
Multithreading: Introduction, Life Cycle of a Thread, Creating Thread, Thread Schedular, Sleeping a thread, Joining a thread, Thread Priority, Daemon Thread, Thread Pooling, Thread Group, ShutdownHook, Performing multiple task by multiple thread, Garbage Collection, Runnable class
Synchronization: Synchronization : What and Why?, synchronized method, synchronized block, static synchronization, Deadlock, Inter-thread Communication, Interrupting Thread
Input and output: FileOutputStream & FileInputStream, ByteArrayOutputStream, SequenceInputStream, BufferedOutputStream & BufferedInputStream, FileWriter & FileReader, CharArrayWriter, Input from keyboard by InputStreamReader, Input from keyboard by Console, Input from keyboard by Scanner, PrintStream class, PrintWriter class, Compressing and Uncompressing File, Reading and Writing data simultaneously, DataInputStream and DataOutputStream, StreamTokenizer class
Serialization: Serialization & Deserialization, Serialization with IS-A and Has-A, transient keyword
Networking: Socket Programming, URL class, Displaying data of a web page, InetAddress class , DatagramSocket and DatagramPacket, Two way communication

AWT and EventHandling: AWT Controls, Event Handling by 3 ways, Event classes and Listener Interfaces, Adapter classes, Creating Games and Applications
Swing: Basics of Swing, JButton class, JRadioButton class, JTextArea class, JComboBox class, JTable class, JColorChooser class, JProgressBar class, JSlider class, Digital Watch, Graphics in swing, Displaying Image, Edit Menu for Notepad, Open Dialog Box, Creating Notepad, Creating Games and applications
LayoutManagers: BorderLayout, GridLayout, FlowLayout, BoxLayout, CardLayout
Applet: Life Cycle of Applet, Graphics in Applet, Displaying image in Applet, Animation in Applet, EventHandling in Applet, JApplet class, Painting in Applet, Digital Clock in Applet, Analog Clock in Applet, Parameter in Applet, Applet Communication, Creating Games
Reflection API: Reflection API, newInstance() & Determining the class object, javap tool, creating javap tool, creating appletviewer, Accessing private method from outside the class
Collection: Collection Framework, ArrayList class, LinkedList class, ListIterator interface, HashSet class, LinkedHashSet class, TreeSet class, PriorityQueue class, ArrayDeque class, Map interface, HashMap class, LinkedHashMap class, TreeMap class, Hashtable class, Comparable and Comparator, Properties class
JDBC: JDBC Drivers, Steps to connect to the database, Connectivity with Oracle, Connectivity with MySQL, Connectivity with Access without DSN, DriverManager, Connection interface, Statement interface, ResultSet interface, PreparedStatement, ResultSetMetaData, DatabaseMetaData, Storing image, Retrieving image, Storing file, Retrieving file, Stored procedures and functions, Transaction Management, Batch Processing, JDBC New Features, Mini Project
Java New Features: Assertion, For-each loop, Varargs, Static Import, Autoboxing and Unboxing, Enum Type, Annotation etc.
Internationalization: Internationalization, ResourceBundle class, I18N with Date, I18N with Time, I18N with Number, I18N with Currency

References:

1. Cay S. Horstmann & Gary Cornell, Core Java Volume I (7th ed.), Sun Microsystems Press Java Series, 2006.
2. Cay Horstmann, Computing Concepts with Java Essentials (5th ed.), John Wiley & Sons, 2006.
3. Herbert Schildt, Java: The Complete Reference, 8th Edition, Tata McGraw Hill, 2011.
4. Balaguruswamy E, Programming with Java:A Primer, Tata McGraw Hill
5. Dietel & Dietel, JAVA-How to program, Prentice Hall Publication
6. Bruce Eckel, Thinking in Java, Pearson Education, 2006.
7. H.M. Deitel and P.J. Deitel, Java-How to Program (7th ed.), Prentice Hall, 2006.
8. Daniel Liang, Introduction to Java Programming (5th ed.), Prentice Hall, 2005.
9. Patrick Naughton, The JAVA handbook, Tata McGraw Hill Publications
10. Paul Deitel and Harvey Deitel, Java How to Program, 9th Edition, Prentice Hal, 2012.
11. Cay S.Horstmann and Gary Cornell, Core Java Volume II - Advanced Features, Eighth edition, PHI, 2008.

CS 13: Mathematical Foundation in Computer Science

Computability: Russell's paradox, Non-computability and examples of non-computable problems.

Permutations, combinations, generation of permutation and combinations, mathematical induction.

Discrete Probability: Sample Space, events, axioms, conditional probability, Bayes' theorem.

Mathematical logic: Formal language, connectives, truth assignments and truth tables, well-formed-formulae, Tautology, contradiction and satisfiability, introduction to predicate calculus.
Combinatorics: Elementary counting principles, the rules of sum and product, Pigeonhole principle, inclusion-exclusion principle, measures of information and mutual information, Combinatorial problems.

Discrete numeric function and generating functions, linear recurrence relations and solutions, Matrix manipulation algorithm.

References:

1. Elements of Discrete Mathematics – C.L. Liu, Tata McGraw-Hill.
2. Combinatorics theory and application – V. Krishnamurth, East-West Publication.
3. Discrete Mathematical structures with Application to Computer Science – J.P. Tremblay & R Monda, Tata McGraw-Hill.

CS 11L: Data Structure using Java Lab

Students should practice design and implementation of the following using Java:

1. Classes and Objects and Interfaces.
2. Exception handling with user defined Exceptions.
3. String Handling (String Class objects - String Manipulation functions).
4. Streaming
5. Multiple Threads Creation, Thread Synchronization using any application.
6. Reading and Writing Objects using Serialization.
7. Creation of User Interfaces using SWING.
8. Creation and Manipulation of generic objects.
9. Implementation of any Information System using JDBC.
10. Database Connectivity using Java Bean.
11. Abstract Data type Implementation of List - Stack and Queues.
12. Array and Linked List implementation of Stack, Queue, Circular Queue.
13. Set ADT- Bit Vector Implementation
14. Tree Representation and Traversals (preorder, inorder, postorder)
15. Graph Representations and Traversals
16. Shortest Path Implementation.
17. Spanning Tree Implementation.
18. Sorting Algorithms.
19. Searching Algorithms.

CS 12L: Digital Design Lab

Design of simple digital circuits with at least one digital IC.

Sessional

Circuit design	: 15 marks
Documentation	: 5 marks
Viva-voce	: 5 marks
Total	**: 25 marks**

CS 21: Microprocessors and Advance Computer Architecture

Microprocessors: Microcomputer, microprocessor and evolution, Assembly language, microprocessor architecture and its operations, memory input/output, interfacing devices, 8085 based microcomputer system, addressing modes, instruction classification, format, timings and operation status; Instruction set, Data transfer instructions: Arithmetic operations, logic and branch operation, Looping, counting and indexing, 16 bit arithmetic instructions, arithmetic operation related to memory, logic operations: rotate, compare, counters and time delays; Stack, subroutine call and Return instruction, parallel input/output, 8255 programmable peripheral interface, 8253 Programmable timer, The 8085 Interrupts: 8259 programmable interrupt controller, Direct Memory Access, 8257 DMA controller, Restart as software instruction

Advance Computer Architecture: Introduction – Instruction set architecture (ISA) and Hardware system architecture (HSA), family of computer architecture, Different computer architectures, Measuring the quality of computer architecture – generality, applicability, efficiency, ease of use, expandability.

Register transfer language (RTL): differences with programming language, notations, control function, micro-operations, inter-register transfer – serial transfer, parallel transfer, bus transfer: need for having a bus system, design of bus using multiplexers/decoders and tri-state devices.

Basic computer organization and design – instruction codes, opcode, register configuration, instruction code formats – memory reference, register reference and I/O instructions, timing and control – design of hardware control unit, computer cycle control – fetch, indirect and execute cycles, cases of some instructions including branch and subroutine call, I/O configuration, interrupt cycle, design of accumulator register.

Microprogrammed control, control word, microprogram, control memory, advantages over hardware control, outline of microprogrammed control organization: next address generator (sequencer), control address register, control memory and control data register, address sequencing: associated hardware.

Instruction pipelining, advantages, breaking instruction cycle to achieve pipelining.

Storage technologies, memory array organization, memory hierarchy, cache and virtual memories, associative memory; Preliminary ideas of parallel, superscalar and vector processors.

References:

1. Mano, Morris, Computer System Architecture, 3rd Edition, PHI.
2. Stallings, William, Computer Organisation an Architecture, PHI.
3. Hwang, Kai, Advanced Computer Architecture, Tata McGraw Hill.

CS 22: Software Engineering

Introduction to Software Engineering: Program Vs. Software, definition, origin, importance, evolution, paradigm, principles, characteristics of software engineering, software crisis, product and process

Software Processes: SW process and phases, different SDLC models, risk-driven, evolutionary and prototyping approaches, Fourth Generation Techniques, Agile methods, Software Components and CBSD.

Requirement Engineering: Role and skills of system analyst, requirement gathering techniques, problem analysis and tools, feasibility study, software requirements and types, requirement engineering process, elicitation, requirements definition, requirement review and verification, static and dynamic requirement specifications, characteristics of a good SRS, prototype outline for SRS-IEEE

System Architecture & Design: Various Design Concepts, notations, importance and design process, Design Tools and Techniques, Prototyping, Design Heuristic, Abstraction, Modularity, Cohesion, Coupling, Documentation, Designing for reuse, Design Patterns, design for change, subsystems, Concurrency, Software Architecture, The 4+1 View of Software Architecture, Design Quality attributes; Enterprise Architecture, Architectural frameworks, IEEE 1471, ISO 42010, Product line architectures, Architecture Evaluation; SOAD- Introduction, importance, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, Functional modeling- Data flow diagrams, Specifying operations, Project Dictionary, limitations of SOAD-towards OOAD; OOAD & UML-UML as a language, UML notations; Object Modeling, Dynamic modeling; User Interface Design- Elements of good design, Design issues, Features of a modern GUI, Menus, scrolling, windows, Icons, Panels, Error messages, etc.

Coding: Programming Languages and types, selection of programming languages, coding standards, guidelines, practices, programming styles, structured and object oriented programming, Information Hiding, Selection of suitable database system, reusability, extensibility, robustness, code documentation, static analysis, symbolic execution, code quality and efficiency

Software Testing: Introduction, software bugs, error, fault, failure, cost of bugs, objectives and purpose of testing, taxonomy of software testing, verification and validation, test case, test data suit preparation, test coverage; testing methodology- functional and structural testing, static and dynamic testing, data testing, state testing, formal reviews, code review checklist, data coverage, code coverage; testing approaches- black box testing techniques, equivalence class partition and boundary value analysis, white box testing techniques, domain and path testing, component testing; level of testing- unit testing, component testing, integration testing, system testing, alpha testing, beta testing, acceptance testing; testing types- configuration testing, compatibility testing, foreign language testing, usability testing, security testing, website testing; automated testing and test tools-benefits of automation and tools, viewers and monitors, drivers, stubs, stress and load tools, analysis tools; test documentation- goal of test planning, test phases, test strategy, resource requirements.

Software Maintenance: Software maintenance and its need, Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Maintainability, Documentation to facilitate maintenance

System Documentation: User Manual User Profile, Contents of a User Manual, Student is urged to install and use a software using its user manual and report the strengths and weaknesses of that user manual.

Software Configuration Management- Base Line, SCM process, Version Control, Change Management, Software Configuration Items

Computer Aided Software Engineering- CASE, Tools for Project management Support, Analysis & design, Programming, Prototyping, Maintenance, advantages, limitations, Future of CASE

References:

1. Roger S. Pressman, Software Engineering A Practitioners Approach, Seventh Edition, TMH, 2009
2. Ian Sommerville, Software engineering, Ninth Edition, Pearson Education, 2010.

3. Pankaj Jalote, An Integrated Approach to Software Engineering, Third Edition, Narosa publications, 2011.
4. Watts S.Humphrey,A Discipline for Software Engineering, Pearson Education, 2008.
5. James F. Peters and Witold Pedrycz, Software Engineering, Engineering Approach, Wiley-India, 2007.
6. Stephen R. Schach, Software Engineering, Seventh Edition, TMH, 2006.
7. Ivar Jacobson, Object Oriented Software Engineering, Pearson Education,1992.
8. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
9. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
10. Douglas Bell, Software Engineering for Students, 4th ed., Addison-Wesley, 2005.
11. Booch, G., Object Oriented Analysis and Design, 2nd edition, Benjamin/Cummins Publishing Co .. Redwood City, CA, U.S.A., 1994.
12. Rumbaugh, J., Et al, Object Oriented Modeling and Design, PHI, 1991.
13. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice.
14. Beizer, B., 'Software Testing Techniques", Second Edition. Van Nostrand Reinhold. New York. 1990.

CS 21L: Microprocessor and Interfacing Lab

Using 8085/8086 microprocessor kits, interfacing with PC, writing and executing assembly language programs using PC, conversion to hex code, downloading to kit, executing programs in the kit from the PC, uploading programs from kit to PC, disassembling.

CS 22L: Visual Programming Lab

Visual Basic, the Language: Familiarizing with Integrated Development Environment, Designing the Loan. Calculator, Designing the Math Calculator, Implementing the Loan and Math calculator using multiple forms, Designing a price calculator using check boxes, Creating games using random numbers, Designing Mark sheet, Creating Notepad, Creating a Speed measuring program using scroll bar, Creating an application that can select any shape and also change the border, Creating stop watch using timer control, Using file controls, Creating calendar, Creating thermometer, Simulate dice rolling, Creating tic-tac-toe game.
Database Applications: Connecting visual basic with oracle, Designing the Theatre Booking System, Designing Bus Reservation System.

CS 31: Internet and Web Technology

Internet and Web: Introduction and Evolution of Internet, WWW, Understanding Browsers, Internet protocols and applications i.e. FTP, Telnet, Email, Chat etc.; Semantic Web Information System, Quality Evaluation and Web Engineering and Application Development, Web Design and Development issues, challenges, Web Design Methods; Web Protocols: TCP, IP and HTTP, SMTP, POP3, FTP; Measuring and Evaluating Web Application

Static Web Design with HTML: Introduction, Evolution, Features of HTML, Filenames in HTML, Tools required, Tags and their Types, Attributes, Comments, Structures of HTML tag, Rules for writing a HTML program, starting a HTML document i.e. How to open Notepad, How to open HTML page, Editing the HTML program, Building web pages with different HTML tags, Frames, forms etc, *HTML Editors and Tools*- Use of different HTML editors and tools like Microsoft Front Page, Dreamweaver etc., Designing Web Application with Web ML and Web

Ratio; *Graphical and Animation Tools*- Use of Different graphical and animation tools like Abode Photoshop, Gif Animator, Macromedia flash etc.

Introduction to DHTML, CSS and XML: Introduction, Creating interactive and dynamic web pages, Cascading Style Sheets, Types of Style Sheets (Inline, Internal and External), Class Selector, ID Selector, Absolute Relative Positioning, Inline menu, DIV + CSS Layout Design, PSD to CSS Conversion , transition from HTML to XML, structuring with schema DTD, XML schemas, building blocks of XML document; creating elements, attributes and entities; Validating XML, XML Schema, XML Processing DOM, SAX, Presental XSL, Transformation XSLT, XPath, XLink, XQuery, XML Security and meta framework, XML signature, XML Encryption, SAML, XKMS, AJAX, RSS, JSON, WS-Security, RDF, semantic Web service, Transforming XML with XSL, Integrating XML with database

Client side scripting: JavaScript, JavaScript Objects, DOM, Java Script, ASP.NET, VB Script

Server Side Scripting: Overview of servlets, Servlet API, Servlet life cycle, Servlet based Web Application, Servlet configuration, Running Servlet with database connectivity, Servlet support for cookies, Session tracking; Basics of ASP, JSP, PHP, ASP.NET, Comparison of ASP, PHP and JSP technologies

JAVA GUI and Database Connectivity: Generic classes, Generic methods, Applets, Applet life cycle methods, Applets based GUI, GUI components, Basic of Swings, Accessing database with JDBC, basics.

Enterprise Application Development: Three Tier Architecture, Working With MVC, JCP, J2EE, Overview of Java beans, XML Based APIs, Application Servers, Presentation Tier and EIS Tier, Java Mail, JMS, Java Transactions, JNDI, Java Authentication and Authorization Services, Java Cryptography

Hosting Website & Security: Hosting a Website, Web Security and issues, Firewalls, cyber laws

Database Integration: Designing the Databases and linking the web pages with the database using PHP,

Advanced Topics: *SOA*-SOA Basics, Principles, Evolution and implementation; *Components and Frameworks*- Service and Data Tier, EJB Architecture, Session Beans, Entity Beans, Message Driven Beans, J2EE Connector Architecture, Web Services, J2EE Web Services, Patterns, Presentation, Service Tier and Data Tier Patterns, J2ME, Struts, Hibernate, Spring; Web Services and Service Composition- *Web Clients*- Browsers, cookies, spiders, search engines and agents, Web Proxies; *Web Services*– Definition, Design and modeling of web services, Web Services and EAI, Web Services Technologies, web services Architecture, WS-Addressing, Routing, Security, Policy, Web Service invocation framework, Service Coordination and Composition protocols

References:

1. A Navarro, Mastering XML, BPB
2. Achyut S Godbole and Atul Kahate, Web Technologies, TMH
3. Ann Navarro, Effective Web Design, BPB publications.
4. C. Xavier, Web Technology and Design, TMH
5. David A Chappell, Tyler Jewell, Java Web Services
6. David Busch, Cascating Style Sheets complete, McGrawHill.
7. Freunk p.coyle, XML, web Services and the Data Revolution, Pearson, 2002.
8. Ivan Bayross, Sharanam Shah, PHP 5.1 for Beginners (Book/CD-Rom) Paperback – February 15, 2006

9. Ivan Bayross, Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl, CGI, BPB.
10. P. J. Deitel and H. M. Deitel, Internet and World Wide Web: How to Program - 4th Edition
11. Patrick Naughton and Herbertz Schildt, Java-2 The complete Reference, TMH.
12. Raj Kamal, Internet and Web Technologies, TMH
13. Robert W. Sebesta, Programming with World Wide Web, Pearson Education, 2008.
14. Sandeep Chatterjee and James Webber, Developing Enterprise web services: An Architect's Guide, PHI, 2004.
15. Scott Robert Ladd, Dynamic HTML complete, McGrawHill.

CS 32: Data Communication and Computer Networks

Introduction to Communication Systems: Fundamentals of Digital Communication. Communication channel, Data communications and Networking, Data transmission concepts and terminology, Theoretical basis of data communication; analog and digital signals, Modulation- Digital to Analog and Analog to Analog conversion techniques, Interfaces and Modems- DTE-DCE Interface, Modems, Cable modems, bandwidth, channel, baud rate of transmission, asynchronous and synchronous transmission, Transmission modes and medium, broadband and baseband transmission, Problems with digital transmission, Transmission Impairments, Performance criteria of a communication system;

Encoding and Decoding: data encoding and modulation techniques, Line and Block coding, Scrambling techniques, pulse code modulation, Variable length codes , transmission errors - error handling mechanisms, Error detection codes, Information Theory -Measure of Information, Entropy, Discreate and Continious channel, Shannon's encoding algorithms, Shannon-Hantly Theorem, Data compression;

Bandwidth utilization techniques: Multiplexing, Frequency division, Time division and Wave division multiplexing, Spread spectrum concepts Baseband data transmission, Baseband pulseshaping, Inter Symbol Interface (ISI), Dubinary Baseband PAM, System Many signaling schemes, Equalisation, Synchronisation Scrambler and Unscrambler; Band-pass data transmission system ASK, PSK, FAK, DPSK &PSK, MSK, Modulation schemes coherent and Non Coherent detector. Probability of Error (PE), Performance Analysis and Comparison; Synchronous and Asynchronous transmission, Modem, Serial interface, Circuit Switching, Packet Switching, Hybrid switching, Architecture of computer network, OSI model, Data communication protocols.

Introduction to Computer Network: Uses of Computer Networks, Types of Computer Networks, OSI Reference Model, Example Networks;

Physical Layer: Data and signal fundamentals, Transmission impairments, Attenuation, Distortion, Noise, Data rate limits for noisy and noiseless channels, Performance; Digital Transmission – Problems with digital transmission, Different line coding schemes, Block coding schemes, Scrambling techniques, Analog to digital encoding. Analog Transmission; Transmission Media - Guided (wired) media – Twisted pair cable, Coaxial cable and Fibre optic cable, Unguided (wireless) media – Different propagation modes, Radio waves, Terrestrial microwaves, Satellite communication; Concept of multiplexing, Frequency division multiplexing, Time division multiplexing – Synchronous and Statistical time division multiplexing, Handling variable length data, Pulse stuffing. Concept of spreading spectrum, Frequency hopping spread spectrum and Direct sequence spread spectrum;

Data Link Layer: Link Layer Services, Error detection and Correction Techniques, Multi Access Protocols, Link Layer Addressing, Ethernet, Hubs, Switches and Switches, Point to Point Protocol, Asynchronous Transfer Mode, Multiprotocol Label Switching;

Network Layer: Introduction, Virtual Circuit and Datagram Networks, IP Addressing, Subnetting, Routing Algorithms (Link State, Distance Vector, Hierarchical), Routing in the Internet (RIP, OSPF, BGP), Broadcast and Multicast Routing Algorithms, Routers, ICMP, IPv6 ;
Transport Layer: Introduction to Transport Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection Oriented Transport: TCP, Principles of Congestion Control, TCP, Congestion Control, Sockets, Quality of services (QOS);
Application Layer: Web and HTTP, Domain Name Space (DNS), Electronic Mail (SMTP, MIME, IMAP, POP3), File Transfer Protocol, Cryptography

References:

1. A.S.Tanenbaum, Computer Networks; Pearson Education Asia, 4th Ed. 2003.
2. Behrouz A.Forouzan, Data Communication and Networking, 3rd Ed. Tata McGraw Hill, 2004.
3. Peterson & Davie, "Computer Networks, A Systems Approach", Harcourt, Latest edition.
4. Bertsekas and Gallagher Data Networks, PHI, Latest Edition
5. William Stallings, Data and Computer Communications, Ninth Edition, PHI, 2004.
6. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers, 2012.
7. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Sixth Edition, Addison-Wesley, 2008.
8. W. Tomasi, Introduction to Data Communications and Networking, Pearson Education, 2007.
9. S. Haykin, Digital Communications, John Wiley & Sons, Inc., 2005.
10. P.C. Gupta, Data Communications and Computer Networks, Prentice-Hall of India,2006.
11. Unix Network Programming: Networking APIs: Sockets and XTI, (Volume 1) by W. Richard Stevens, 2nd Edition, Prentice Hall India, 1999.

CS 31L: Web Technology Lab

Students are to practically implement the following types of applications:

1. Web programming with HTML tags, CSS for styling, Page layout
2. Develop webpage using JavaScript for client side programming and HTML forms
3. Using The DOM and the JavaScript object models
4. Website optimization: crunching HTML, using CSS to replace HTML and light-weight graphics to speed up websites
5. Creating XML file with XML DTD and XML schema, SAX, XSL
6. Web site creation with PHP for server side programming for storing current date-time using cookies and for storing page views using sessions
7. Web application development using Servlet/ PHP/ JSP/ ASP.NET
8. Working with PHP and MySQL.
9. Constructing dynamic server-side web pages using JSF and integrate the Web application with any of the other Java2 Enterprise Edition application server methodologies such as Enterprise Java Beans, JavaMail, and SOAP.
10. Developing Java Enterprise Applications Using EJB3 Session beans, entity beans and message-driven beans.
11. Working with JNDI, JDBC and JMS.
12. Application development using J2ME.
13. Creation of web pages having dynamic contents and validation using Java script.

14. Creation of XML file and validation using XML schema and generation of XML using tools.
15. Simple xml based applications using DOM, SAX and XSL.
16. Basic Java programming covering objects, inheritance, polymorphism, interfaces, packages and exception handling.
17. String handling programs and regular expression programs.
18. Creation of applet based GUIs.
19. Application involving applet based GUI, JDBC, Servlet, JSP/PHP, cookies and session tracking.
20. Designing typical website for different types of organizations

CS34S: Seminar

Seminar topics will be allotted to the students of each group by the teacher concerned.

CS 41: Parallel Computing

Review of Sequential Computing: *Uniprocessor Architecture*- The CPU, Memory, I/O and Networking, Design Tradeoffs; *Enhancing Uniprocessor Performance*- Increasing Processor Clock Frequency, Parallelizing ALU Structure, Using Memory Hierarchy, Pipelining, Very Long Instruction Word (VLIW) Processors, Instruction-Level Parallelism (ILP) and Superscalar Processors, Multithreaded Processor, Performance bottlenecks of sequential computing,
Introduction to Parallel Computing: Motivation, What is Parallel Computing and Why to Use? Concurrent, Parallel, Distributed computing, interacting with hardware- Composite Capabilities, How Do Languages and Environments Assist with These Tasks? Applications of Parallel Computing, RAM and PRAM model, PRAM pseudocode, Data vs. Task parallelism,
Parallel Computers Architectures: Modifications to the Von-Neumann Model, Memory Barriers, Memory Hierarchy and organization, Different types of memory access-UMA and NUMA, Shared memory, distributed memory and distributed shared memory architectures, Cache Coherence and Memory Consistency, classification of parallel computers, Flynn's Classical Taxonomy, ILP, Multi-threaded architectures and TLP, Pipeline Parallelism, I/O Operations; Overheads- Hardware System Architecture, Costs of Operations; Parallel Architecture Design Tradeoffs and Future Directions, SIMD Processors, Systolic Processors, Cluster Computing, Grid and Cloud Computing, Multicore Systems, GPU computing, Synchronization and Mutual Exclusion; Scalability and Load Balance,
Interconnection Networks: Introduction, Communication Between Parallel Processors, Classification of Interconnection Networks by Logical Topologies, Interconnection Network Switch Architecture, Routing Mechanisms for Interconnection Networks,
Performance Analysis and Tuning: Measuring Benefits of Parallel Computing, Performance, Performance Metrics, Scalability and Scalability Metrics, Speed up, Amdahl's law, Gustafson–Barsis's Law, efficiency, Scalability, Granularity, Latency, Bandwidth, Throughput, Cache, false sharing, Performance Analysis Tools- Tau.
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, templates, Basic parallel programming techniques-loop splitting, spin locks, contention barriers and row conditions, Variations in splitting, self and indirect scheduling. Data dependency-forward and backward, block scheduling.

References:

1. Barry Wilkinson and Michael Allen. Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, Second Edition. Prentice-Hall, 2005.
2. Michael J. Quinn. Parallel Programming in C with MPI and OpenMP. McGraw-Hill, 2004.
3. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar. Introduction to Parallel Computing, Second Edition. Addison-Wesley, 2003.
4. Introduction to Parallel Computing by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar - Pearson Publication
5. Introduction to Parallel Processing by M. Sasi Kumar, Dinesh Shikhare P. Raviprakash - PHI Publication
6. Parallel Computers – Architecture And Programming by V. Rajaraman And C. Siva Ram Murthy
7. An Introduction to Parallel Programming, by Peter S. Pancheo, 2011.
8. Introduction to parallel programming by Brawer, S., Academic Press, New York, 1989.
9. Bruce P. Lester. The Art of Parallel Programming, Second Edition. 1st World Publishing, 2006.
10. Kenneth A. Berman and Jerome L. Paul. Algorithms: Sequential, Parallel, and Distributed. Thomson Course Technology, 2005.

CS 41L: Parallel Programming Lab

Students are to learn at least one parallel programming language/extensions suitable to different parallel programming models and should practice the implementation of programs like the followings:

Basic Applications: sending and receiving data to/from multiple processing nodes, Calculation the value of PI, Finding Partial Sum, Average, mean squared deviation, curve fitting, numerical integration, traveling salesman problem, Gaussian elimination, Discrete event time simulation

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

Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quick sort

Dense Matrix Algorithms; Matrix-Vector Multiplication, Matrix-Matrix Multiplication, dense matrix algorithms, sparse matrix algorithms, Solving a System of Linear Equations

Graph Algorithms: Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths

Fast Fourier Transform: The Serial Algorithm, The Binary-Exchange Algorithm, The Transpose Algorithm, Cost-Effectiveness of Parallel FFT Algorithms,

CS43P: Project

Students have to undergo a project on real problems at the department.

CS44V: Grand Viva

Questions will be asked from the subjects taught in the entire course.

Detailed Syllabus of Elective Papers

CS 23E Electives

E21: Automata Theory & Formal Languages

Introduction to the theory of computation: Symbol, alphabet, sets, relations and functions, strings and languages. *Finite state machines:* Finite automata definition & description, transition system, DFA, NFA, equivalence of DFA and NFA, Conversion of NFA to DFA, finite automata with outputs, Moore machine, Melay machine ,equivalence between Moore and Melay machines, Chomsky Hierarchy of languages,

Regular expressions and regular grammars: Regular expressions, equivalence of regular expressions and FA, Regular sets and properties: Regular set, Pumping lemma for regular sets, closure properties of regular sets, Regular grammars, Right linear and Left linear grammar, equivalence between Regular linear grammar and FA inter conversion between RE and RG.

Context free languages: Introduction, context free grammars, derivation trees, single ficatum of context free grammars, leftmost and rightmost derivations, ambiguity in CFG, simplification of CFG, normal forms-Chomsky normal form CNF, Greibach normal form GNF, Enumeration of properties of CFL.

Pushdown automata: Definition, model, acceptance of CFL, deterministic PDA, nondeterministic PDA, the pumping lemma for CFL's, closure properties of CFL's, A context Free Grammar corresponding to a given context free grammar, equivalence of CFL and PDA

Turing machines: Definition, model, representation of TM, design of TM, Computable Languages and Functions of Turing Machines, Techniques of turing machine construction, types of TM, Universal Turing machine, computable languages and function, Halting Problem, Modifications of Turing machine, Church's Hypothesis, Linear bounded automata and context sensitive languages, Introduction of DCFL and DPDA, Decidability of problems.

Computability & Recursion: Basic definition of computable and non-computable functions, primitive Recursive, Recursive and partial Recursive functions, RICE theorem and Greibach theorem, PCP and un decidability, Properties of recursive & non recursive enumerable languages, post correspondence problem

References:

1. Hopcroft, J., and Ullman, J., *Introduction to Automata Theory, Languages and Computation*, Addison-Wesley,
2. Introduction to Languages and the theory of Computation, John C. Martin, Tata McGraw-Hill-Edition
3. Introduction to Formal Languages, Automata theory and Computation Kamala Krithivasan, Rama R. Pearson Education
4. An Introduction to Formal Languages and automata by Peter Liz.
5. Introductory theory of Computer Science"- V.Krishnamurthy (EWP)
6. Introduction To Automate Theory, Languages & Computation by J.E Hopcraft & JD Ullman, Narosa Publications.
7. Mathematical theory of computation By Mannaz
8. Theory of Computer Science by KLP Mishra & N.Chandra Sekharan, PHI

E22: Principles of Programming Languages

Introduction: Concepts of programming languages, Programming domains, Language Evaluation Criteria, language definition - syntax and semantics; compilation versus interpretation, influences on Language design, Language categories, Programming Paradigms – Imperative, Object Oriented, functional Programming , Logic Programming. Programming Language Implementation –

Compilation and Virtual Machines, programming environments, The halting problem and computability, Turing completeness;

Syntax and Semantics: formal specifications, general Problem of describing Syntax and Semantics, formal methods of describing syntax - BNF, EBNF for common programming languages features, tokenizing versus parsing, recursive descent parsers; parse trees, one-token look ahead parsing, abstract syntax trees; ambiguous grammars, attribute grammars, denotational semantics and axiomatic semantics for common programming language features, attributes and binding; scope; symbol tables; allocation and storage classes; variables; pointers

Data types: Introduction, primitive, character, user defined, array, associative, record, union, pointer and reference types, design and implementation uses related to these types. Names, Variable, concept of binding, type checking, strong typing, type equivalence and compatibility, type systems; type inference; type coercion, named constants, variable initialization,

Expressions and Statements: Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures – Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, guarded commands.

Control: expressions, selection, loops, go-to, parameters, activation records for function calls

Subprograms and Blocks: Fundamentals of sub-programs, Scope and lifetime of variable, static and dynamic scope, Design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

Abstract Data types: Abstractions and encapsulation, introductions to data abstraction, design issues, language examples, C++ parameterized ADT, object oriented programming in small talk, C++, Java, C#, Ada 95 Concurrency: Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads.

Exception handling: Exceptions, exception Propagation, Exception handler in Ada, C++ and Java.

Functional Programming Languages: Introduction, functional algorithms; tail-recursion; fundamentals of FPL, LISP, ML, Haskell, application of Functional Programming Languages and comparison of functional and imperative Languages. Scripting Language: Pragmatics, Key Concepts, Case Study : Python – Values and Types, Variables , Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library, lambda calculus -conversions, Church-Rosser theorem, fixed-points,

Object-oriented Programming: Polymorphism, Exceptions, Lazy evaluation, Reflection, Inheritance and subtyping, Concurrency and synchronization ("threads")

Logic Programming Language: Introduction and overview of logic programming, basic elements of prolog, application of logic programming, Horn clause logic, resolution and unification

References:

1. Programming Languages Paradigm and Practice, 2nd edition, Doris Appleby, Julius J. Vandekopple, Tata McGraw Hill.
2. Concepts of Programming Languages Robert .W. Sebesta 8/e, Pearson Education,2008.
3. Programming Language Design Concepts, D. A. Watt, Wiley dreamtech,rp-2007.
4. Programming Languages, 2nd Edition, A.B. Tucker, R.E. Noonan, TMH.
5. Programming Languages: Principles and Practice, 3rd edition. Kenneth C. Louden.
6. Krishnamurthi, *Programming Languages: Application and Interpretation*, ver.

E23: Design and Analysis of Algorithms

Introduction: Framework for Algorithms Analysis, Asymptotic Notations, Basics, Euclid's algorithm, Problem, Instance, RAM model, RAM model

Asymptotic complexity: Some stylistic issues Analysis of Algorithms, O(log n) bit model , Principles of Algorithm Design, Finding Maximum and Minimum

Algorithm Design Techniques: Introduction to Iterative techniques, Divide and conquer, dynamic programming, greedy algorithms.

Divide and Conquer Technique: Introduction, Binary Search, Merge Sort, Quick Sort, Multiplication of Large Integers, Sorting, Median Finding, Surfing Lower Bounds, Closest Pair, Strassens Matrix Multiplication algorithm.

Dynamic Programming: Combinatorial Search, Longest common subsequence, 0-1 Knapsack Problem, Matrix chain multiplication or Optimal search trees, A machine scheduling problem, shortest path, Travelling salesman problem.

Greedy Algorithms: Introduction, Set of Intervals, Minimum spanning tree, Union find, Set cover, Knapsack problem, Fractional Knapsack, Huffman Coding, Pattern Matching

Searching and Sorting Techniques: Review of elementary sorting techniques-selection sort, bubble sort, insertion sort; more sorting techniques-quick sort, heap sort, merge sort, shell sort; external sorting; Comparison Tree, Lower bound on comparison-based sorting, Sorting in Linear Time, Counting Sort, Radix Sort.

Lower bounding techniques: Decision Trees, Adversaries.

Number Theoretic Algorithms: GCD, Addition and Multiplication of two large numbers, polynomial arithmetic, Fast-Fourier Transforms.

Graphs: Analysis of Graph algorithms Depth-First Search and its applications, minimum Spanning Trees and Shortest Paths.

String Processing: KMP, Boyre-Moore, Robin Karp algorithms.

Introduction to randomized algorithms: Random numbers, randomized Qsort, randomly Built BST, Advanced Techniques to analyze algorithms: Use and study advanced data structures unionfind (Disjoint Set Structure), Fibonacci heaps.

Complexity Analysis: Complexity measures, Worst, Best and Average Case, Upper and Lower bounds, Order Notations, Introduction to Branch and Bound and backtracking techniques.

NP-Completeness: Classes of Problems, Easy and Hard Problems, The classes P, NP, NP-hard and NP-complete, Proving NP-completeness, Examples of NP-complete problems such as 3SAT, CLIQUE, VERTEX COVER etc., Matching and Flows, Search/Decision, SAT, Independent Set, 3VC, Exact Cover, Multi Set, Subset Sum & Partition, Hamiltonian Circuit, Concept of Reduction, Approximation Algorithms, Approximation Algorithms for NP , Amortised Analysis, Backtracking: n-queens problem; Parallel Algorithms- Basic techniques for sorting, searching and merging in parallel, Point location, Convex hulls and Voronoi diagrams.

References:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Indtroduction to Algoritms, PHI, 2006.
2. J. Kleinberg and E.Tardos, Algorithms Design, Pearson Education, 2006.
3. S.Baase, Computer algorithms: Introduction to Design and Analysis, Addison Wesley, 1999.
4. A.V. Levitin, Introduction to the Design and Analysis of algorithms, Pearson Education, 2006.
5. Sara Baase, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1999.
6. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995.
7. Teofilo F.Gonzalez, Handbook of NP-Completeness: Theory and Applications Chapman & Hall, 2009.
8. Vijay V. Vazirani, Approximation Algorithms, Springer-Verlag, France, 2006.
9. S. Rajasekharan and John Reif, Handbook of Parallel Computing: Models,algorithms and applications, Chapman and Hall/CRC, 2007.
10. Gareth A. Jones and Josephine M. Jones, Elementary Number Theory, Springer, 1998.

11. F P Preparata and M I Shamos, Computational Geometry: An Introduction Springer, 1993.
12. Sahni and Horowitz: Fundamentals of Computer Algorithms

E24: Real Time and Embedded Systems

Introduction: Embedded Systems, Challenges of Embedded Systems, fundamental components, examples of embedded systems, hardware fundamentals, gates, timing diagrams, memory, DMA, buses, interrupts, schematics, build process of embedded systems, examples.

Embedded System Design And Implementation: Requirements of an embedded system, Meeting real time constraints, Multi-state systems and function sequences, architecture styles and patterns, design methodologies and practices, implementation aspects and choices, 8051/89c51 and Advanced Processor Architectures, Memory Organization and Real world Interfacing, Memory access procedure, types of memory, memory management methods, Pointer related issues, polling versus interrupts, types of interrupts, interrupt latency, reentrancy, interrupt priority, programmable interrupt controllers, interrupt service routines.

Real-Time Operating Systems: Desktop Operating Systems versus RTOS, Basic design using an RTOS, need for Board Support Packages, Interrupt handling in RTOS , task management, race conditions, priority inversion, scheduling, inter task communication, timers, semaphores, queues, OS Security Issues; *RTOS Programming*- Micro/Os-II and VxWorks : Basic Functions and Types of RTOSES, RTOS mCOS-II, RTOS VxWorks Real-time Operating System, Windows CE, OSEK and Real-time Linux functions. Windows CE, OSEK, Linux 2.6.x and RTLinux

Programming Concepts and Embedded Programming in C, C++ and Java: Software Programming In Assembly Language (ALP) and in High-level Language C, Object-Oriented Programming, Embedded Programming in C++, Embedded Programming in Java.

Embedded Software Development Tools: Host and target machines, cross compilers, linker and locators for embedded software, Emulators and debuggers, address resolution, locating program components, initialized data and constant strings, PROM programmers, ROM emulators, Flash memory.

References:

1. Raj Kamal, Embedded Systems Architecture, Programming and Design, TMH 2nd Edition
2. Raj Kamal, Microcontroller, 2nd Indian Print
3. Sriram V.Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw Hill publishers, 2004.
4. Ajay Deshmukh, Microcontrollers: Theory and Applications, TMH
5. David E. Simon, An Embedded Software Primer, Pearson Education publishers, 1999.
6. Dr. K. V. K. K. Prasad, Embedded Real Time Systems: Concepts, Design and Programming Dreamtech Press
7. Frank Vahid & Tony Givargus, Embedded System Design, Willey Publication
8. Frank Vahid and Tony Givargis, A unified Hardware/Software Introduction, Embedded System Design, John Wiley & Sons publishers, 2002.
9. M.A. Mazidi & J.G. Mazidi & R.D. McKinley Raj Kamal, The 8051Microcontroller and Embedded Systems, 2nd Edition

CS 33E Electives

E31: System Software and Compiler Constructions

System Software: Introduction, Definition, Role and Functions, characteristics, types

Assembler: Introduction, functions, features, design of one pass and two pass assemblers;

Macroprocessors: Introduction, functions, features and design;
Loader and Linkers: Basic Concepts of Linkers and Loader Functions, Boot Loaders, Linking Loaders, Linkage Editors, Dynamic Linking
Compiler: Introduction to Compiler, Difierent phases and passes of compiler
Compiler Structure, Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.
Lexical Analysis: Role of Lexical Analyzer, Interface with input, parser and symbol table, Input Buffering, Specification of Tokens, lexeme and patterns; difficulties in lexical analysis; error reporting; Finite state machines and regular expressions and their applications to lexical analysis, regular definition, transition diagrams, Lex., Review of regular languages, design and implementation of a lexical analyzer,
Syntax Analysis: Role of the parser, Formal and context free grammars(CFGs) and their application to syntax analysis, ambiguity, associatively, precedence, Derivation and parse trees, Top Down parsing, LL(1) grammars, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, Shift Reduce Parsing, LR(0) grammars, operator precedence grammars, LR parsing algorithms and LR parsers, Yacc.
Syntax directed translation and Definitions: Syntax directed definitions, Construction of syntax trees, Top down and bottom up approaches, dependency graph, data types, mixed mode expression; subscripted variables, evaluation order and sequencing statement, Inherited and synthesized attributes, bottom up and top down evaluation of attributes, L- and S-attributed definitions.
Type Checking: Type system, type expressions, structural and name equivalence of types, type conversion.
Run Time System Environments: Source Language issues, Storage organization, Storage Allocation strategies, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation, Access to non-local names, Parameter passing mechanism
Intermediate Code Generation: Intermediate languages, Intermediate Graphical representations, Three address code, Implementation of three address statements (Quadruples, Triples, Indirect triples), translation of declarations, assignments, control flow, Boolean expressions and procedure calls, implementational issues.
Code Optimization and generation: Introduction and Issues, Basic blocks and flow graphs, Transformation of basic blocks, DAG representation of basic blocks, code generation from dags, Loops in flow graph, Principle sources of optimization, Peephole optimization, machine dependent and machine independent optimization techniques, Issues in the design of code generator, Register allocation and assignment, code generation, specifications of machine.
Subroutines and functions: parameters called by address, by name and by value, subroutines with side effects.

References:

1. A. V. Aho, R. Sethi and J. D. Ullman, Compilers: Principles, Techniques, and Tools (US edition), Addison Wesley, 1986.
2. A. Holub, Compiler Design in C, Prentice-Hall of India, 2006.
3. R. Mak, Writing Compilers and Interpreters (2nd ed.), John Wiley & Sons, 1996.
4. D. Galles, Modern Compiler Design, Pearson Education, 2007.
5. S. Chattopadhyay, Compiler Design, Prentice-Hall of India, 2005.
6. Alfred Aho, Monica S. Lam, Ravi Sethi, Jefirey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education Asia (2nd Ed. - 2009).
7. Leland L. Beck, System Software: An Introduction to Systems Programming, 3/E, Addison-Wesley, 1997.
8. Allen I. Holub Compiler Design in C, Prentice Hall of India, 2003.
9. C. N. Fischer and R. J. LeBlanc, Crafting a compiler with C, Pearson Education.

10. J.P. Bennet, Introduction to Compiler Techniques, Second Edition, TMH, 2003.
11. Henk Alblas and Albert Nymeyer, Practice and Principles of Compiler Building with C, PHI, 2001
12. Kenneth C. Louden, Compiler Construction: Principles and Practice, Thomson Learning.
13. Systems Programming and Operating Systems D. M. Dhamdhere, TMH
14. John J. Donovan, Systems Programming, 3rd edition, 1997, Addison Wesley.

E32: Computer Graphics

Introduction to Computer Graphics: Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Color CRT Raster Scan Basics, Video Basics, The Video Controller, Random-Scan Display Processor, LCD displays

2D Transformations: Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of The Unit Square, Solid Body Transformations, Rotation About an Arbitrary Point, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates, The Window-to-Viewport Transformations

3D Transformations: Introduction, Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, A_ne and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, the Perspective Geometry and camera models, Orthographic Projections, Axonometric Projections, Oblique Projections, View volumes for projections.

Viewing in 3D: Stages in 3D viewing, Canonical View Volume (CVV), specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of Planar Geometric Projections, Combined transformation matrices for projections and viewing, Coordinate Systems and matrices, camera model and viewing pyramid, Scan conversion-Lines, circles and Ellipses; Filling polygons and clipping algorithms, Scan Converting Lines, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons, edge data structure, Clipping Lines algorithms Cyrus-Beck, Cohen Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components.

Solid Modeling: Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Spatial-Partitioning Representations, Octree representation, B-Reps, Constructive Solid Geometry, Comparison of Representations

Visible-Surface Determination: Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painters algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods

Illumination and Shading: Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenuation, Phongs model, Gouraud shading, some examples.

Plane Curves and Surfaces: Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, A Procedure for using Conic Sections, The General Conic Equation; Representation of Space Curves, Cubic Splines,

Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces. Bezier Surfaces

Graphics Programming using OPENGL: Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL GL, GLU & GLUT, 3D viewing pipeline, viewing matrix specifications, a few examples and demos of OpenGL programs.

Miscellaneous topics: Why Realism? Aliasing and Anti-aliasing, texture bump mapping, Animation methods, methods of controlling animation, soft modeling of objects, image based rendering, Fundamental Difficulties.

Image Manipulation and Storage: What is an Image? Digital image file formats, Image compression standard JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering.

References:

1. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics Principles and Practice, Second Edition in C, Pearson Education, 2003.
2. D. Hearn and M. Pauline Baker, Computer Graphics (C Version), Pearson Education, 2nd Edition, 2004.
3. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw-Hill International Edition, 1990.
4. F. S. Hill Jr., Computer Graphics using OpenGL, Pearson Education, 2003.

E33: Digital Image Processing and Steganography

Fundamentals of Image Processing: Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels and distance measurement, connectivity, Image Geometry, Photographic film, Light, Brightness adaption and discrimination, Perspective Projection, Spatial Domain Filtering, Color fundamentals, color models (RGB, CMY, HIS), formulation, color complements, color slicing, tone and color corrections, image file formats

Image Filtering: *Spatial Domain Filtering*- Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian; *Frequency domain Filtering*- Hotelling Transform, Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering, Inverse filtering, Least squares filtering. Recursive filtering

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Hufiman Coding,
Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation; Wavelet based Image Compression- Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking; Fidelity criterion- MSE, PSNR, Compression ratio,

Image Restoration: Basic Framework and models, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.
Image Segmentation: Definition, Detection of Discontinuities, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Iterative and Multivariable thresholding, Otsu's method, Moving averages, Boundary detection based techniques; Characteristics of segmentation, Pixel based, Region based and histogram based segmentation methods, segmentation by sub region aggregation, split and merge technique, Watershed segmentation, Use of motion in segmentation (spatial domain technique only),
Image Enhancement: *Spatial Domain Methods*- Arithmetic and Analytical operations, pixel or point operations, size operations) Smoothing filters Mean, Median, Mode filters. Low pass filters, high pass filters, sharpening filters; *Frequency Domain Method*- Design of Low Pass, High Pass, Edge enhancement, Sharpening filters in frequency domain, Bufier Worth Filter, Homomorphic filters in frequency domain and spatial domain.
Steganography: Introduction, importance, steganography related issues and techniques, Application

References:

1. Gonslaez, et.a1, "Digital Image Processing", Addison Wesley, Reading, M.A., 1990.
2. Anil K Jain; Fundamentals of Digital Image Processing.
3. Rafael C Gonzalez, Richard E Woods; Digital Image Processing, Pearson Education
4. Rafael C Gonzalez, Richard E Woods, Eddins; Digital Image Processing using MATLAB,Pearson Education.
5. B Chanda & D Dutta Majumder; Digital Image Processing and Analysis, PHI.

E34: Cloud and Grid Computing

Introduction to Grid Computing: What is a grid? Infrastructure of hardware and software, Main Projects and Applications, The Open Grid Forum, International Grid Trust Federation; Grid Architecture, Overview of Resource Managers, Overview of Grid Systems; Application Management: Grid Application Description Languages, Application Partitioning, Meta-scheduling, Mapping, Monitoring; Web Services, Grid Portals,
Cloud Computing Overview: What is a cloud, Definition of cloud, Characteristics of cloud, Why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial), Cloud Computing and SOA, Enterprise Cloud drivers and adoption trends, Typical Cloud Enterprise workloads, Cloud service models/types, Cloud deployment models, Cloud ROI models, Cloud reference architectures, Cloud standards, Technology providers vs. Cloud providers vs. Cloud vendors, Planning Cloud transformations
Cloud service delivery: Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Platform as a service (PaaS) architecture, Platform as a service (PaaS), Software as a service (SaaS) architecture, Examples of SaaS applications, Business Process as a Service (BPaaS) Architecture, Trade-off in cost to install versus, Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform.
Cloud deployment scenarios: Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: IBM Smart Cloud
Security in cloud computing: Cloud security, Cloud security reference model, How security gets integrated, Cloud security challenges, Understanding security risks, Cloud security approaches: encryption, Digital signature, tokenization/ obfuscation, cloud security alliance standards, cloud

security models and related patterns; Virtualization and multitenancy, Internal security breaches, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches, Steps to reduce cloud security breaches; Identity detection, forensics and management, What is SSL? Cloud security in mainstream vendor solutions; Mainstream Cloud security offerings: security assessment, secure Cloud architecture design; Design a secure Cloud architecture to support the deployment of a secure version of the course project application.

References:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010
5. M. N. Rao, Cloud Computing, PHI

E35: Mobile and Pervasive Computing

Mobile Computing: Introduction, Differences between Mobile Communication and Mobile Computing, Contexts and Names; Functions, Applications and Services, Design Considerations, Integration of Wireless and Wired Networks Standards Bodies;

Wireless Transmission and Networks: Wireless Transmission, Signal Propagation, Spread Spectrum, Satellite Networks, Frequency/Capacity Allocation, FAMA, DAMA, MAC; *Wireless networks*- Wireless LAN, IEEE 802.11 Standard, Architecture, Services, AdHoc Network, HiperLan, Blue tooth, WiFi, WiMAX, 3G, WATM; Cellular Wireless Networks, GSM, Architecture, Protocols, Connection Establishment; *Routing*- Mobile IP, DHCP, Proactive and Reactive Routing Protocols, Multicast Routing; Handover, GPRS; Transport And Application Layers- TCP over Adhoc Networks, Mobile IP protocols -WAP push architecture; WWW Programming Model, WDP, WTLS, WTP, WSP, WAE, WTA Architecture, WML, WML Scripts and applications

Sensor and Mesh Networks: Sensor Networks, Role in Pervasive Computing in Network Processing and Data Dissemination, Sensor Databases, Data Management in Wireless Mobile Environments, Wireless Mesh Networks Architecture, Mesh Routers, Mesh Clients Routing, Cross Layer Approach, Security Aspects of Various Layers in WMN, Applications of Sensor and Mesh networks

3g and 4g Cellular Networks: Migration to 3G Networks, IMT 2000 and UMTS, UMTS Architecture, User Equipment Radio Network Subsystem, UTRAN Node, B RNC functions, USIM Protocol Stack, CS and PS Domains, IMS Architecture, Handover 3.5G and 3.9G, a brief discussion 4G LAN and Cellular Networks, LTE Control Plane, NAS and RRC User Plane, PDCP, RLC and MAC WiMax IEEE 802.16d/e WiMax Internetworking with 3GPP

Context Aware Computing: Adaptability Mechanisms for Adaptation, Functionality and Data Transcoding, Location Aware Computing, Location Representation, Localization Techniques, Triangulation and Scene Analysis, De-launay Triangulation and Voronoi graphs, Types of Context, Role of Mobile Middleware, Adaptation and Agents, Service Discovery Middleware;

Mobile computing environment: Functions-architecture-design considerations, content architecture, CC/PP exchange protocol, context manager; Data management in WAECoda file system, caching schemes, Mobility QOS, Security in mobile computing.

Handoff in wireless mobile networks: reference model-handoff schemes, Location management in cellular networks, Mobility models, location and tracking management schemes, time, movement, profile and distance based update strategies, ALI technologies

Open protocols: Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications, Context aware security

Pervasive Computing: Basics, Vision and Principles; Characteristics- interaction transparency, context aware, automated experience capture; Architecture for pervasive computing, Pervasive devices, Categories of Pervasive Devices, embedded controls, smart sensors and actuators, Context communication and access services

Application Development: Three tier architecture, MVC Architecture, Memory Management, Information Access Devices, PDAs and Smart Phones, Smart Cards and Embedded Controls, J2ME Programming for CLDC, GUI in MIDP Application Development ON Android and iPhone.

References:

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, Mobile Computing: Technology, Applications and Service Creation, Second Edition, TMH, 2010.
2. Reto Meier, Professional Android 2 Application Development, Wrox Wiley, 2010.
3. Pei Zheng and Lionel M Li, Smart Phone & Next Generation Mobile Computing, Morgan Kaufmann Publishers, 2006.
4. Frank Adelstein, Fundamentals of Mobile and Pervasive Computing, TMH, 2005.
5. Jochen Burthardt et al, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Pearson Education, 2003.
6. Feng Zhao and Leonidas Guibas, Wireless Sensor Networks, Morgan Kaufmann Publishers,2004.
7. Uwe Hansmaan et al, Principles of Mobile Computing, Springer, 2003.
8. Reto Meier, Professional Android 2 Application Development, Wrox Wiley, 2010.
9. Stefan Poslad, Ubiquitous Computing: Smart Devices, Environments and Interactions,Wiley, 2009.
10. Ivan Stojmenovic , Handbook of Wireless Networks and Mobile Computing, John Wiley & sons Inc, Canada, 2002.
11. Asoke K Taukder,Roopa R Yavagal,Mobile Computing, Tata McGraw Hill Pub Co. , New Delhi, 2005.
12. Jochen Schiller, "Mobile Communications", PHI/Pearson Education, Second Edition, 2003.
13. William Stallings, "Wireless Communications and Networks", PHI/Pearson Education, 2002.
14. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", PHI/Pearson Education, 2003.
15. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, New York, 2003.
16. C.K.Toh, "AdHoc Mobile Wireless Networks", Prentice Hall, Inc, 2002.
17. Charles E.Perkins, "AdHoc Networking", Addison-Wesley, 2001.
18. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York, 2007.
19. Uwe Hansmann etl , Pervasive Computing, Springer, New York,2001.

CS 42E Electives

E41: AI and Expert System

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem solving: State space search- Production systems; Search space control-Depth first search, breadth first search, heuristic search – Hill climbing, best first search, branch and bound; Minimax search- Alpha-Beta cutoffs.

Knowledge Representation: Predicate Logic- Skolemizing queries, Unification, Modus pones. Resolution, dependency directed backtracking.

Rule Based Systems- Forward reasoning, Conflict resolution, Backward reasoning- Use of no backtrack.

Structured Knowledge Representations: Semantic Net: slots, Frames.

Handling uncertainty: Probabilistic reasoning, Use of certainty factors, Fuzzy logic.

Learning: Concept of learning, learning automation, genetic algorithm, learning by induction, neural nets-back propagation.

Expert Systems: Need and justification for expert systems, Knowledge acquisition

Case studies: MYCIN, RI.

References:

1. Nilsson, N.J., "Principles of AI", Narosa publishing House, 1990.
2. Patterson, D.W., "Introduction to AI and Expert Systems", Prentice Hall of India, 1992.
3. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Publishing Company, M.A., 1992.
4. Rich. E., and knight, K., "Artificial Intelligence", Tata McGraw Hill (2^{nd} Edition), 1992.
5. Schalkoff, R.J., "Artificial Intelligence – An Engineering Approch", McGraw Hill International Edition, Singapore, 1992.
6. Sasikumar, M. Ramani, S., "Rule Based Expert System", Narosa Publishing House, 1994.

E42: Data Warehousing & Data Mining

Introduction to Data Mining: Definition of data mining ,Data Mining functionalities, Classification of data mining systems , Data Mining Applications, Architectures of data mining systems, Data mining class comparison.

Data Mining Algorithms: Concept Description: Definition, Data Generalization and Summarization –Based Characterization, Mining Descriptive Statistical Measures in Large Databases; Mining Association Rules: Association Rule Mining, Market Basket Analysis,

Association Rule Classification, The Apriori Algorithm, Mining Multilevel Association Rules, Constraint-Based Association Mining, Sequential mining

Classification and Prediction: What is Classification and Prediction? Data Classification Process, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification Based on Association Rule Mining, Other

Classification Methods Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis, Categorization of Clustering Methods, Partitioning methods

Introduction to Data Warehousing: Introduction to Decision Support System: DSS Definition, History of DSS, Ingredients of DSS, Data and Model Management, DSS Knowledge base, User Interfaces, The DSS Users, Categories and Classes of DSSs Need for data warehousing, Operational & informational data, Data Warehouse Definition and characteristics, Operational Data Stores

Data warehouse Components: Architectural components, Data Preprocessing: Why Preprocess Data? Data Cleaning Techniques, Data Integration and Transformation, Data Reduction Techniques, Discretization and Concept Hierarchy, Generation for numeric and categorical data, Significant role of metadata, Building a Data warehouse, Benefits of Data Warehousing.

OLAP in the Data Warehouse: A Multidimensional Data Model, Schemas for Multidimensional Databases: Stars, Snowakes, Star join and Fact Constellations Measures, Concept Hierarchies, OLAP Operations in the Multidimensional Data Model, Need for OLAP, OLAP tools , Mining Multimedia Databases, Mining Text Databases, Mining the World Wide Web.

References:

1. Jiawei Han, Micheline Kamber; Data Mining: Concepts and Techniques, Morgan Kaufmann, ISBN 1558609016, 2006.
2. Paul Punnian; Data Warehousing Fundamentals, John Wiley Pub
3. Alex Berson, S.J. Smith; Data Warehousing, Data Mining and OLAP, TMH
4. Margaret Dunham; Data Mining: Concepts and Techniques, Morgan Kaufmann Pub.
5. Ralph Kimball; The Data Warehouse Lifecycle toolkit, John Wiley

E43: Soft Computing

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing; Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies; Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Optimization: Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.

Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory; Propogation Networks- introduction, Counter propagation network, architecture, functioning & its characteristics, Back Propogation Networks - Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Hopfield/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications; Hopfield v/s Boltzman machine; Adaptive Resonance Theory: Architecture, classifications, Implementation and training; Associative Memory.

Fuzzy Logic: Basic concepts of crisp and fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion; Fuzzy rule base system-Membership functions, features of membership functions, fuzzy reasoning, interference in fuzzy logic, fuzzy decision making, fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Applications of fuzzy logic, Industrial applications,

Genetic Algorithm(GA): Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, fitness function, reproduction, Genetic modeling: Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator; Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

Hybrid Systems: Integration of neural networks, fuzzy logic and genetic algorithms.

References:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
2. Siman Haykin,"Neural Netowrks"Prentice Hall of India
3. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
4. Kumar Satish, "Neural Networks" Tata Mc Graw Hill
5. J. Yen and R. Langari.. Fuzzy Logic, Intelligence, Control and Information, Pearson Education.
6. J. S. R. Jang, C. T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.

E44: Information Security and Cyber Forensics

Information Security Concepts: Introduction, History, Critical Characteristics of Information, Information System and its components, Security Vs. Protection, Need for Security, Information Security Overview, Goals for Security, Securing the Components, Information Security Services, The Security SDLC, Business Needs, Security Threats and Vulnerabilities , Attacks and Types of Attacks, Legal, Ethical and Professional Issues, Balancing Security and Access, NSTISSC Security Model, E-commerce Security, Computer Forensics, Steganography, Security Engineering

Security Threats, vulnerabilities and Scanning: Overview of Security threats, Hacking Techniques, Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs, Cyber crime and Cyber terrorism, Information Warfare and Surveillance, Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet

Network Defense tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System

Web Application Tools: Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra

Network and Computer Security: Cryptography, Access Control and Intrusion Detection, Access Control Devices, Physical Security, Security and Personnel, Security issues in wireless

Cyber Security: Introduction, Weak / Strong Passwords and Password Cracking, Web Browsers Security, Email Security: PGP and SMIME, Web Security: web authentication, SSL and SET, Firewall And Utm,

Cyber Forensics: Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks

Cyber Crimes and Law: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Realms of the Cyber world, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Cyber Law, Indian IT Act, 2000, Information Security Policy, Standards and Practices, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity, SSE-CMM / COBIT, ISO 17799/BS 7799, ISO

27001, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

References:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, 2003.
2. Matt Bishop, "Computer Security Art and Science", Pearson Education, 2002.
3. Ron Weber, "Information Systems Control and Audit", Pearson Education, 2004.
4. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", TMH, 2003.
5. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
6. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley
7. Garms, Jess and Daniel Somerfield. Professional Java Security. Wrox. 2001.
8. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
9. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", Tata McGraw -Hill, New Delhi, 2006.
10. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.
11. Understanding Forensics in IT, NIIT Ltd, 2005.

E45: Cryptography & Network Security

Introduction to Classical Cryptosystems: Introduction, Need and importance of Cryptography, Classical Cryptosystems, Introduction to symmetric and asymmetric cryptography, Cryptanalysis of Classical Cryptosystems, Shannons Theory

Mathematical Foundations: Number Theory, Number Theoretic Results, Factorization- Factoring Algorithms, Quadratic Sieve Factoring Algorithm, Pollard-Rho Method; Modular Arithmetic-Groups, Solving Modular Linear Equations, Chinese Remainder Theorem, Modular Exponentiation, Discrete Logarithm Problem; GCD Computation- Euclids Algorithm, Extended Euclids Algorithm, Probability and Information Theory, The Discrete Logarithm Problem (DLP), Computation of Generators of Primes; Stream Ciphers, Pseudorandom functions.

Symmetric Key Ciphers and Cryptanalysis: Introduction, Symmetric Key Ciphers, Modern Block Ciphers- DES, AES; Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers

Hash Functions and MACs: Hash functions, The Merkle Damgard Construction, Message Authentication Codes (MACs)

Asymmetric Key Ciphers and Cryptanalysis: Construction and Cryptanalysis, RSA Cryptosystem, Different Attacks & Remedies on RSA, Semantic Security of RSA, The Discrete Logarithm Problem (DLP), Diffie Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Massey-Omura; Construction and Cryptanalysis, Cryptanalysis of DLP

Modern Trends in Asymmetric Key Cryptography: Overview of Modern Cryptography, Elliptic curve theory and Elliptic Curves based cryptography, Security of Elliptic Curves Cryptography, Elliptic Curve Factorization.

Digital Signatures: Introduction, Signature schemes, Authentication Protocols, Digital Signature Standards (DSS), Proxy Signatures

Network Security: Secret Sharing Schemes, Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls

Primality Testing: Primality Testing, Quadratic Residues, Randomized Primality Test & Deterministic Polynomial Time Algorithm

References:

1. Introduction to Algorithms: T. H. Cormen, C. E. Leiserson, R. Rivest and C. Stein Prentice Hall India, 2nd Edition, 2002.
2. A Course in Number Theory and Cryptography: Neal Koblitz, Springer Verlag, New York Inc. May 2001.
3. Cryptography and Network security: Principles and Practice, William Stallings, Pearson Education, 2002.
4. Introduction to Cryptography with Coding Theory, Second Edition, W. Trappe and L. C. Washington, Pearson Education 2007.
5. Cryptography: Theory and Practice, Douglas R. Stinson, CRC Press.
6. Randomized Algorithms, R. Motwani and P. Raghavan, Cambridge University Press, 1995.
7. Douglas Stinson, "Cryptography Theory and Practice", 2nd Edition, Chapman & Hall/CRC.
8. B. A. Forouzan, "Cryptography & Network Security", Tata Mc Graw Hill.
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10. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
11. Ho_stein, Pipher, Silvermman, "An Introduction to Mathematical Cryptography", Springer.
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13. A. Joux,"Algorithmic Cryptanalysis", CRC Press.
14. S. G. Telang, "Number Theory", Tata Mc Graw Hill.
15. C. Boyd, A. Mathuria, "Protocols for Authentication and Key Establishment", Springer.
16. Matt Bishop, "Computer Security", Pearson Education

E46: Software Project Management and SQA

Introduction to SW Project Management (SPM): Introduction, Concept of Project, Need and importance of SW Project, concept of management, Evolution of Software Economics, Software Management Process Framework, Software Management Disciplines, Problem with SW projects, Modern Project Profiles, Project Evaluation- Strategic Assessment, Technical Assessment, Cost Benefit Analysis

SW Project Planning: Defining the problems, developing a solutions strategy, planning the development process, activity involved in SW project planning, Steps in SW project planning, planning an organizational structures.

SPM Activities and Activity Planning: Objectives, Project Schedule, Sequencing and Scheduling Activities, *Umbrella Activities*- Metrics, Configuration Management, Software Quality Assurance; *In Stream Activities*- Project Initiation, Project Planning, Execution and Tracking, Project Wind up, Concept of Process/Project Database, Network Planning Models i.e PERT and CPM, Shortening Project Duration

Software Estimation & Costing: cost factors, software cost estimations, Problems in Software Estimation, Algorithmic Cost Estimation Process, Function Points, Software Life cycle Management, COCOMO, Estimating Web Application Development, Concepts of Finance, Activity Based Costing and Economic Value Added (EVA), estimating software maintenance cost,

Risk Management: Definition, Categories, Nature and Types of SW project risk , Risk Assessment, Risk Management, Risk Control, Failure Mode and Effects Analysis (FMEA), Hazard Identification and Analysis, Risk Planning And Control.

Monitoring and Control: Creating Framework, Collecting the Data, Visualizing Progress, Cost Monitoring, Earned Value, Priortizing Monitoring, Getting Project Back To Target, Change Control, Managing Contracts, Introduction, Types of Contract, Stages In Contract Placement, Typical Terms of a Contract, Contract Management, Acceptance.

Metrics: Need for Software Metrics, Classification of Software Metrics: Product Metrics (Size

Metrics, Complexity Metrics, Halstead's Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-based Models, Composite Models, and Reliability Models)

Managing People and Organizing Teams: Introduction, Becoming a Team, Organizational and team Structures, Team Management, Client Relationship Management, Case Studies.

SW Quality Fundamentals: SW quality concept- what and why? Benefits and importance, SW Quality models i.e. McCall, Boehm, FURPS, Dromey, ISO 9001, 9126 etc., Cost of Poor quality,

SQA: Introduction, roles and benefits, SQA and quality control, SQA planning and activities, SQA process framework i.e. ISO, CMM, Six-Sigma, TMMi, People CMM etc. and their relevance to Project Management

Fundamentals of Software Quality Assurance: Ethical Basis for Software Quality, Total Quality Management Principles, Software Processes and Methodologies.

Quality Standards: Quality Standards, Practices and Conventions, Software Configuration Management, Reviews and Audits, Enterprise Resource Planning Software.

Quality Metric System: Concepts, Measurement Theory, Software Quality Metrics, importance and categories of metrics, Metrics Program (GQM), Designing Software Measurement Programs, Complexity Metrics and Models, Organizational Learning, Improving Quality with Methodologies, Structured/Information Engineering, commonly used metrics i.e. Process, Product and Resource metrics.

Test Management: Recap of SW Testing fundamentals, Test Management and activities involved, Evaluation of Test Effectiveness, release management, Test management tools

Tools for Quality Improvement: Basic quality control tools, check sheet, C&E diagram, Pareto diagram, histogram, Scatter Plot, Run Chart, Control Chart, orthogonal defect classification,

References:

1. McConnell, S. "Software Project: Survival Guide", Microsoft Press, 1998.
2. Royce, W. "Software Project management: A Unified Framework", Addison Wesley, 1998.
3. Fenton, N.E., and Pfleeger, S.L.. "Software Metrics: A Rigorous and Practical Approach, Revised" Brooks Col , 1998.
4. Demarco, T. and Lister, T. "Peopleware: Productive Projects and Teams, 2nd Ed.", Dorset House, 1999.
5. Humphrey,Watts,"Managing the Software Process ",Addison Wesley,1986.
6. Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, TMH, 2004.
7. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
8. Royce, "Software Project Management", Pearson Education, 1999.
9. Jalote, "Software Project Manangement in Practice", Pearson Education, 2002.
10. Schulmeyer, G. Gordon, James McManus, "Handbook of Software Quality Assurance", Second Edition, Van Nostrand Reinhold, 1992.
11. Anirban Basu, Software Quality Assurance, Testing and Metrics, First Edition, PHI