MASTER OF COMPUTER SCIENCE

SYLLABUS

FOR

CREDIT-BASED CURRICULUM
(Applicable for 2014-2015 onwards)

DEPARTMENT OF COMPUTER APPLICATIONS

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI-620 015

TAMIL NADU - INDIA

HEAD OF THE DEPARTMENT:

1. Dr.A.Vadivel

MEMBERS OF THE DEPARTMENT:

1. Dr. N.P. Gopalan
2. Dr. A.V. Reddy
3. Dr. B. Ramadoss
4. Dr. Michael Arock
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9. Dr. (Mrs). B.Janet
10. Dr. S. Sangeetha
11. Dr. R. Eswari
12. Dr. U. Srinivasulu Reddy
13. Dr.M.P.Anuradha (On Contract)
14. Dr.V.Gayathri (On Contract)
15. Dr.S.Suresh (On Contract)
16. Dr.R.Siva Shankar (On Contract)

Semester	Subject Code	Subject Name	L	T	P	C
I	CAS 761	Mathematical Foundations of Comp. Science	3	0	0	3
	CAS 763	Computer Organization and Architecture	2	1	0	3
	CAS 765	Data Structures and Algorithms	2	1	0	3
	CAS 767	Data Base Management System	2	1	0	3
	CAS 769	Operating Systems	3	0	0	3
	CAS 751	Programming Lab for DSA	0	0	4	2
	CAS 753	Operating systems Lab – Unix & Shell Prog	0	0	4	2
II	CAS762	Fundamentals of Parallel Programming	3	0	0	3
	CAS 764	Data mining	2	1	0	3
	CAS 766	Computer Networks	3	0	0	3
	CAS 768	Computer Graphics and Multimedia	3	0	0	3
	CAS 7A_	Elective-I	3	0	0	3
	CAS 752	Parallel Programming Lab	0	0	4	2
	CAS 754	DBMS and Data Mining Lab	0	0	4	2
III	CAS 771	Web Technology	2	1	0	3
	CAS 773	Mobile and Pervasive Computing	3	0	0	3
	CAS 775	Object Oriented Software Engineering	3	0	0	3
	CAS 7B_	Elective-I	3	0	0	3
	CAS 7C_	Elective-II	3	0	0	3
	CAS 755	Project work- Phase I	0	0	4	2
	CAS 757	FOSS Lab	0	0	4	2
IV	CAS 799	Project Work –Phase II	0	0	0	10
		Grand Total	**40**	**5**	**24**	**67**

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

LIST OF ELECTIVES

Subject Code	Subject Name	L	T	P	C
CAS 7A1	Big Data Analytics	3	0	0	3
CAS 7A2	Soft Computing	3	0	0	3
CAS 7A3	Computer Security	3	0	0	3
CAS 7B1	GPGPU programming	3	0	0	3
CAS 7B2	Image Processing	3	0	0	3
CAS 7B3	Cryptography	3	0	0	3
CAS 7C1	Design Patterns	3	0	0	3
CAS 7C2	Internet of Things	3	0	0	3
CAS 7C3	Cloud Computing	3	0	0	3

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

SEMESTER - I

CAS761 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Objectives:

- *To acquire skills in solving mathematical and logical problems.*
- *To comprehend mathematical principles and logic.*
- *To understand fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science.*

Set Theory : Sets and operations, properties - power set - methods of proof - relations, graph and matrix of a relation - partial and total orders, well ordering - equivalence relations, classes and properties - functions, 1-1, onto and bijective - composition of relations and functions - inverse functions.

Mathematical Logic : Propositions and logical operators – Truth table – Equivalences and implications – Basic laws– Some more connectives – Functionally complete set of connectives – Review of Propositional Calculus - Validity - Satisfiability related concepts - CNF and DNF forms - Conversion of arbitrary propositional formula to CNF or DNF.

Groups, Rings and Fields: Introduction-Algebraic Structures, Groups, Abelian Group, Order, Cyclic Group, Homomorphism (Definition), Isomorphism (Definition), Kernel of f (Definition), Rings, Field and its Axioms, Sub-fields, Finite Fields, Powers and primitive roots in finite fields.

Basic Number Theory : Basic Notions-Prime Number Theorem, GCD, Euclidean algorithm, Solving $ax + by = d$, Congruence, The Chinese Remainder Theorem, Modular Exponentiation, Fermat and Euler , Primitive Roots, Inverting Matrices Mod n, Square Roots Mod n ,Legendre and Jacobi Symbols, Perfect Numbers and Mersenne Numbers.

Graph Theory : Definitions and basic results - Representation of a graph by a matrix and adjacency list - Trees - Cycles - Properties - Paths and connectedness - Sub graphs - Graph Isomorphism - Operations on graphs - Vertex and edge cuts - Vertex and edge connectivity, Spanning Trees, Euler circuits, Hamiltonian graphs.

References:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", 7th Edition, McGraw-Hill, 2012.
2. Mahima Ranjan Adhikari and Avishek Adhikari, "Basic Modern Algebra with Applications", Springer, 2014.
3. Kolman, Busby and Ross, "Discrete Mathematical Structures", 6th Edition, PHI, 2009.

Outcome:

Students will be able to:

- *Apply the concepts of discrete mathematics in the modeling and design of computational problems.*

CAS763 COMPUTER ORGANIZATION AND ARCHITECTURE

Objectives:

- *To understand the basic structure of a digital computer.*
- *To be conversant with the operations of internal components.*
- *To analyze architectures and computational designs.*

Introduction – Computer Evolution and performance – Function and Interconnection - Number Systems – Digital Logic

Cache memory – Internal memory –External Memory - Input/output

Computer Arithmetic – ALU - Instruction Sets - Addressing modes and formats - Instruction pipeline – RISC - CISC

Register organization - Processor organization – Instruction Cycle - Super scalar processor.

Control Unit Operations - Micro programmed Control – Parallel Processing – Multicore Architecture - APU Architecture

References:

1. William Stallings, "Computer Organization and Architecture", 7th Edition, Prentice Hall, 2013.
2. Hennessy J and Patterson D, "Computer Architecture - A Quantitative Approach", 5th Edition, Morgan Kaufmann, 2011.
3. M. Morris Mano, Michael D. Ciletti, "Digital Design", 4th Edition, Pearson Education, 2011.
4. John Hayes, "Computer Architecture and Organization", 2nd Edition, McGraw Hill, 2002.

Outcomes:

Students will be able to:

- *Identify the internal components in computing systems.*
- *Design and analyze the main functional units of a computer.*
- *Synthesize new and better architectures.*

CAS 765 DATA STRUCTURES AND ALGORITHMS

Objectives:

- *To design and implement different data structures.*
- *To study various searching, sorting techniques and their Applications.*
- *To compute complexity of algorithms.*
- *To be taught algorithm design methodologies.*

Introduction – Arrays – Structures – Stack: Definition and examples, Representing Stacks - Queues and lists: Queue and its Representation, lists – Applications of Stack, Queue and Linked Lists.

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

Algorithms – Analyzing and Designing algorithms – Asymptotic notations – Recurrences – Methods to solve recurrences – Basic sorting techniques – selection sort, bubble sort, insertion sort and merge sort – Basic Search Techniques – linear search and binary search.

Revisiting various operations of different data structures with time complexity analysis – Design and Analysis of Heap Sort - Quick Sort – Sorting in linear time – Radix sort – Selection in linear time.

Design Strategies: Recursion - Divide and conquer methodology – Multiplication of large integers – Strassen's matrix multiplication – Greedy method – Prim's algorithm – Kruskal's algorithm – algorithm for Huffman codes – Dynamic Programming – Backtracking and Branch and bound method.

References

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest and C. Stein, "Introduction to algorithms", 3rd edition, MIT Press, 2009.
2. P. H. Dave and H. B.Dave, "Design and Analysis of Algorithms", Pearson Education India. 2009.
3. S. Lipschutz and G.A.V. Pai, "Data Structures", Tata McGraw-Hill, 2010.
4. Clifford A. Shaffer, "Practical Introduction to Data Structures and Algorithm Analysis", 2nd edition, Prentice Hall, 2000.
5. P. Brass, "Advanced Data Structures", Cambridge University Press, 2008.

Outcomes*:*

Students will be able to:

- *Understand common data structures and algorithms, implement them.*
- *Choose among variety of data structures to design algorithms and solve problems in scientific computing.*
- *Comprehend algorithmic complexity and choose the best among various data structures and algorithms for problem solving, based on complexity.*

CAS 767 DATABASE MANAGEMENT SYSTEMS

Objectives:

- *To understand the needs of a database management system.*
- *To provide a solid technical overview of database management systems, both in terms of usage and implementation.*
- *To be aware of emerging database technologies.*

Introduction : Database System -– Views– Data Models – Database Languages — Database System Architecture – Database users and Administrator – E-R model – E-R Diagrams -- Introduction to relational databases

Relational model: The relational Model -Keys - Relational Algebra – Domain Relational Calculus – Tuple Relational Calculus - Fundamental operations – Additional Operations- SQL fundamentals - Integrity – Triggers - Security – Advanced SQL features –Missing Information– Views –

Database design: Functional Dependencies – Non-loss Decomposition – Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form-Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

Transactions :Transaction Concepts - Transaction Recovery – ACID Properties – System Recovery –Media Recovery – Two Phase Commit - SQL Facilities for recovery – Concurrency – Need for Concurrency – Locking Protocols – Two Phase Locking – Intent Locking – Deadlock- Serializability – Recovery Isolation Levels

Emerging systems: Distributed Data bases – Object oriented Data bases - Mobile Databases- XML and Web Databases. Active and Deductive Databases - Multimedia Databases– Multimedia Data Structures – Multimedia Query languages - Spatial Databases.

References:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson / Addision wesley, 2007.
2. Thomas Connolly and Carlolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3rd Edition, Pearson Education, 2003.
3. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", 5th Edition, Tata McGraw Hill, 2006.

Outcomes:

Students will be able to:

- *Understand the role of a database management system in an organization.*
- *Assimilate basic database concepts and construct database queries using SQL.*
- *Apply logical database design principles in solving real world problems.*

CAS 769 OPERATING SYSTEMS

Objectives:

- *To provide a clear understanding of operating system concepts.*
- *To be aware of the services provided by operating systems and their underlying principles.*
- *To be introduced to various types of operating systems and their design perspectives*.

Operating System concepts - OS Structure – OS Services - System calls – Process management: Process Concept-Operations on process-Cooperating processes- Inter-process communication. Process scheduling-Scheduling algorithms.

Threads- Multithreading models – Containers - Process synchronization- critical-section – Synchronization hardware – Semaphores – Classic problems of synchronization – critical regions. Deadlocks: Characterization, Prevention, Avoidance, Detection, and Recovery.

Memory Management: Paging, segmentation, Demand Paging, Page Replacement, Allocation of Frames.

File Concepts, Access and Allocation Methods, Free Space Management. Disk Structure, Disk Scheduling and Disk Management.

Case Studies: UNIX, Linux and Windows Operating Systems. Overview of Distributed and Mobile Operating systems.

References:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 2010.
2. Andrew S. Tanenbaum, "Modern Operating Systems", 3rd Edition, Prentice Hall, 2007.
3. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2011.
4. Garry Nutt, "Operating Systems", 3rd Edition, Addison-Wesley, 2003.

Outcomes:

Students will be able to:

- *Know the concepts of operating system functions and structures.*
- *Understand the design issues associated with operating systems.*
- *Be familiar with various types of operating systems including UNIX, Linux and windows.*

CAS751 PROGRAMMING LAB FOR DSA

Exercises to implement various algorithms using C/C++/Java

1. Programs using one dimensional, two dimensional arrays.
2. Implementation of Stack, Queue operations.
3. Implementation of operations on singly, doubly, circular linked lists.
3. Implementation of operations on binary tree.
4. Implementation of binary tree traversal.
5. Implementation of basic sorting techniques (selection sort, bubble sort, insertion sort and merge sort).
6. Implementation of sorting techniques like heap, quick and radix sort.
7. Implementation of searching algorithms.
8. Implementation of Strassen's matrix multiplication.
9. Implementation of Greedy method.
10. Implementation of Prim's and Kruskal's algorithm.

CAS 753 OPERATING SYSTEMS LAB – UNIX & SHELL PROGRAMMING

Exercises for learning basic features of UNIX and to solve problems using shell programming

1. Write shell script to perform basic arithmetic, logic and string operations.
2. To write a menu Driven shell program using shell commands with menu options to perform file/directory manipulations.
3. Write a program to implement Round Robin Scheduling.
4. Write a program to implement The Bounded-Buffer problem.
5. Write a program to implement The Reader-Writer Problem.
6. Write a program to implement The Dining Philosopher Problem.
7. Write a program to implement Bankers Algorithm.
8. Write a program to implement the First fit, Best fit, Worst Fit Memory management Techniques.
9. Write a program to implement the FIFO, LRU, OPTIMAL page replacement Techniques.
10. Write a program to implement the FCFS, SCAN, C-SCAN, LOOK, C-LOOK Disk scheduling algorithm.

SEMESTER – II

CAS762 FUNDAMENTALS OF PARALLEL PROGRAMMING

Objectives:

- *To explore the concept of parallel programming and its importance.*
- *To analyze and optimize the complexity of each parallel algorithm.*
- *To familiarize parallel programming paradigms and techniques with introduction to CUDA tool.*

Introduction-Parallel Programming Paradigms-Parallel Architecture- Case studies -Open MP-features and functions - PRAM Model of Computation

PRAM - Models of Parallel Computation, Complexity - Memory Consistency - Performance Issues - Parallel Program Design - Shared Memory and Message Passing – MPI -features and functions

Parallel programming models - Algorithmic Techniques - Decomposition Techniques - Mapping Techniques for load balancing - Algorithms for Matrix operations, Sorting and Searching.

Lower Bounds Lock Free Synchronization, Load Stealing - Lock Free Synchronization, Graph theoretic parallel algorithms

Case Study: CUDA - CUDA threads – CUDA memories - CUDA performance considerations – CUDA floating point considerations – CUDA applications.

References:

1. M J Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw-Hill Education, 2003.
2. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", 2nd Edition, Pearson Education, 2003.
3. D. Kirk and W. Hwu, "Programming Massively Parallel Processors", 2nd Edition, Morgan Kaufmann Publishers, 2010.

Outcomes:

Students will be able to:

- *Design and develop parallel algorithms.*
- *Analyze the real world problems and implement in parallel environment.*

CAS764 DATA MINING

Objectives:

- *To introduce the basic concepts and techniques of data mining.*
- *To develop skills of using recent data mining software for solving problems.*
- *To be aware of advanced concepts of data mining techniques and its applications in the knowledge discovery process.*

Data Mining Techniques-Data Mining Process-Process with a typical set of data-Big Data-Visualization of data through data mining software.

Data Mining Methods as Tools - Memory-Based reasoning methods of Data Mining - Algorithms with prototypical data based on real applications.

Data Stream Mining, Mining Time Series, Text Mining, Data Stream Clustering, mining Big Data

Market Basket Analysis - Fuzzy Data Mining approaches - Fuzzy Decision Tree approaches Fuzzy Association Rule applications. Rough Sets - Support Vector Machines - Genetic algorithms.

Social Computing - Analysis -Graph Mining – Social Network Mining-Web Mining – Web Usage Mining-Privacy Preserving Data Mining-Recommender Systems.

References:

1. David L. Olson and Dursun Delen, "Advanced Data Mining Techniques", Springer, 2008.
2. Charu C. Aggarwal and Haixun Wang, "Managing and Mining Graph Data", Springer, 2010.
3. Ian H. Witten, Eibe Frank and Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann Publishers, 2011.
4. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 2006.
5. Margaret H. Dunham, "Data Mining Introductory and Advanced Topics", Prentice Hall, 2003.
6. Anand Rajaraman and Jeff Ullman, "Mining of Massive Datasets", Cambridge University Press, 2011.

Outcomes:

Students will be able to:

- *Understand the concepts and algorithms of data mining.*
- *Apply data mining techniques for business intelligence.*
- *Be aware of the privacy and security issues in data mining.*

CAS766 COMPUTER NETWORKS

Objectives:

- *To be familiar with existing state-of-the-art in network protocols, architectures, and applications.*
- *To gain comprehensive knowledge about the layered communication architectures and its functionalities.*
- *To understand the principles, key protocols, design issues and significance of various layers.*

Building a network – Requirements – Network Architecture – OSI – Internet – Direct Link Networks LAN Technology – LAN Architecture – BUS/Tree – Ring – Star – Ethernet – Token Rings – Wireless Networks

Error Detection and Correction – LRC - CRC- Checksum – Hamming Distance for Error Correction – simulator development to capture various packets flowing in the Data Link Layer Flow control and error control – Stop and wait – Go back-N ARQ – Selective repeat ARQ – Sliding window protocol

Switching: Packet Switching – Switching and Forwarding – Bridges and LAN switches – Internetworking – Simple Internetworking – Packet switching and datagram approach - IP addressing methods – IP version 4 and 6- Routing - Selective routing protocol specification

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

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

References:

1. Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, McGraw-Hill, 2004.
2. William Stallings, "Data and Computer Communications", 9th Edition, Pearson, 2011.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A systems Approach", 5th Edition, Harcourt Asia/Morgan Kaufmann, 2011.
4. James F. Kurose and Keith W. Ross, "Computer Networking - A Top Down Approach", 5th Edition, Addison Wesley, 2009.
5. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Prentice Hall, 2012.

Outcomes:

Students will be able to:

- *Understand basic network theory and layered communication architectures.*
- *Use and apply current technical concepts and practices in computer network installation.*

Industrial Component: Software Defined Networks.

CAS768 COMPUTER GRAPHICS AND MULTIMEDIA

Objectives:

- *To understand the basic concepts of graphics and multimedia systems.*
- *To acquire skills, to be conversant with technology and to assimilate formal concepts to solve a wide range of graphic design problems.*
- *To become familiar with creation and implementation of multimedia standards and techniques.*

Overview Of Graphics Systems : Introduction – Visualization – Image processing – Graphical User Interface – Video Display Devices –Input Devices – Hard Copy Devices – Graphics Software.

Output Primitives and Attributes of Output Primitives Points and Lines – Line Drawing Algorithms – Circle generating algorithms – Ellipse generating algorithms – Filled area primitives –Antialiasing

Two Dimensional Geometric Transformations: Basic transformations – Matrix representations – Composite Transformations – other transformations – Window–to-Viewport coordinate Transformation –Clipping Operations.

Three Dimensional Concepts and Applications: Three dimensional geometric and modeling transformations - Visible-surface Detection methods-polygon rendering methods-color models and color applications-computer animation.

Multimedia File Handling- Using text in Multimedia-Computer and Text- Font Editing and Design Tools- Hypermedia and Hypertext - Sound – Images – Animation – Video - Digital Video and Image Compression - Redundancy and visibility - The JPEG image compression standard- MPEG motion video compression standard.

References:

1. Donald Hearn and Pauline Baker, "Computer Graphics C version", Pearson Education, 2003.
2. Foley Vandam and Feiner Huges, "Computer Graphics: Principles & Practice", Pearson Education, 2003.
3. Zhigang Xiang and Roy A Plastock, "Schaum's Outline of Computer Graphics", TMH 2000.
4. Tay Vaughan, "Multimedia: Making It Work", 7th Edition, Tata Mc-Graw Hill, 2008.
5. John F.Koegel Buford, "Multimedia Systems", Pearson Education, 2003.
6. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.
7. Ralf Steinmetz and Klara Nahrstedt, "Multimedia: Computing, Communication and Applications", Pearson Education, 2001.

Outcomes:

Students will be able to:

- *Obtain insight into the basics of computer graphics and multimedia.*
- *Analyze and design solutions to problems pertaining to graphics and multimedia.*

CAS752 PARALLEL PROGRAMMING LAB

Exercises to implement parallel algorithms using openMP, MPI etc. with CUDA and other architectures.

1. Implement a parallel program for selection problem.
2. Implement a parallel program for merging problem.
3. Implement a parallel modified quick sort program.
4. Implement a parallel program for searching problem.
5. Implement a parallel program for matrix transpose problem.
6. Implement a parallel program for matrix multiplication problem.
7. Implement a parallel program for convolution problem in image processing.
8. Implement a parallel program for finding connected components problem.
9. Implement a parallel program for all-pairs shortest path problem.
10. Implement a parallel program for minimum spanning tree problem.

CAS754 DBMS AND DATA MINING LAB

Exercises to construct and query databases.
Exercises to implement Data mining algorithms using ENCOG and WEKA

1. Execution of Data Definition Language
2. Execution of Data Manipulation Language
3. Querying the database tables using simple queries, nested queries, aggregate functions and joins
4. Creation of Views
5. Execution of PL/SQL programs – procedures, functions, and cursors
6. Execution of triggers
7. Applications involving finance management systems, vendor management systems etc.
8. Implementation of Apriori algorithm to generate frequent Item Sets
9. Implementation of the following clustering algorithms
    a. K-means
    b. K-medoids
10. Implementation of Decision Tree Induction classification algorithm
11. Performing data Preprocessing using WEKA
12. Performing Discretization of data using WEKA
13. Execution of Apriori algorithm using WEKA
14. Execution of Classification algorithms using WEKA

SEMESTER – III

CAS771 WEB TECHNOLOGY

Objectives:

- *To comprehend basics of the internet and web terminologies.*
- *To introduce the features of HTML5 to develop rich applications.*
- *To introduce scripting language concepts for developing client side applications.*
- *To practice server side programming features – ASP .NET, PHP, JSP.*
- *To be familiar with database applications*
- *To know the usefulness of web services.*

Evolution of Internet - Introduction to Web - Static and Dynamic Web -Principles of Web design - HTML for static web - HTML 5 – Introduction – Elements – Forms – Graphics – Media – APIs – CSS.

JavaScript and DHTML: What is JavaScript? - Simple JavaScript, variables, functions, condition - JavaScript and Objects - DOM and the Web browser Environment – Event Handling - Forms and validation – Cookies – JQuery.

Introduction to ASP – .NET Framework – ASP .NET – Controls – Sessions – Cookies – Form Handling - SQL Server - JSP – Overview – Simple applications.

PHP - Adding PHP to HTML, Syntax and Variables, Passing information between pages, Strings - Arrays and Array Functions – Numbers - Basic PHP errors / problems - Sessions and Cookies and Database Connectivity**.**

Connecting Databases - With ASP, ASP .NET, JSP, PHP – Web Services – Introduction – Elements – XML – RDF – WSDL – UDDI – SOAP – Applications.

References:

1. Kogent Learning Solutions Inc., "Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, And AJAX, Black Book", Dream tech Press, 2012.
2. Harvey M. Deitel and Paul J. Deitel, "Internet & World Wide Web How to Program, 4th Edition, Pearson Education, 2008.

Outcomes:

Students will be able to:

- *Design and develop web applications.*
- *Understand client and server side scripting and their applicability.*

CAS773 MOBILE AND PERVASIVE COMPUTING

Objectives:

- *To introduce the concepts of mobile communication system and pervasive computing.*
- *To understand the concepts of emerging mobile technology.*
- *To be aware of pervasive computing practices.*

Mobile Computing – Networks – Middleware and Gateways – Developing Mobile Computing Applications – Mobile Computing Architecture: Architecture for Mobile Computing – Three-Tier Architecture – Design Considerations for Mobile Computing

Global System for Mobile Communications – GSM Architecture – GSM Entities - Call Routing in GSM – GSM Addresses and Identifiers – Network Aspects in GSM – GSM Frequency Allocation – Authentication and Security -Mobile Computing through Internet –Mobile Computing through Telephone – Emerging Technologies: - Bluetooth – RFID -Wireless Broadband (WiMax) - Mobile IP

Short Message Service (SMS)- Value Added Services through SMS – GPRS- GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations –Data Services in GPRS- Applications for GPRS – Limitations of GPRS – CDMA and 3G- Spread Spectrum Technology- CDMA Versus GSM – Wireless Data – Third Generation Networks – Applications on 3G

Pervasive Computing: Past, Present and Future Pervasive Computing - Pervasive Computing Market – m-Business – Application Examples: Retail, Airline check-in and booking – Sales force automation – Health care – Tracking – Car information system – E-mail access via WAP

Device Technology: Hardware – Human Machine Interfaces – Biometrics – Mobile OS – Programming for Pervasive devices.

References:

1. Ashok K.Talukder and Roopa R.Yuvagal, "Mobile Computing", 2nd Edition, Tata McGraw Hill, 2010.
2. JochenBurkhardt, Horst Henn, Stefan Heper, Klaus Rindtorff and Thomas Schack, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addison Wesley, 2002.
3. UweHansmann, L. Merk, M. Nicllous, T. Stober and U.Hansmann, "Pervasive Computing", Springer Verlag, 2003.
4. Jochen H. Schiller, "Mobile Communications", Addison-Wesley, 2003.

Outcomes:

Students will be able to:

- *Be conversant with various mobile computing ideas and best practices to solve practical problems.*
- *Apply pervasive computing techniques in various domains of importance.*

CAS 775 OBJECT ORIENTED SOFTWARE ENGINEERING

Objectives :

- *To comprehend basics of the software engineering process life cycle.*
- *To be introduced to the object-oriented (OO) approach to software development, through OO principles.*
- *To be conversant with UML (Unified Modelling Language) and the benefits of visual modeling / diagramming.*
- *To get introduced to software engineering principles for both procedural and object oriented approaches.*

Introduction -What is software engineering? – Software Development Life Cycles Models - Conventional Software Life Cycle Models- What is Object Orientation? – Objects and Classes – Features - Object Oriented Software Life Cycle Models -Object oriented Methodologies – Object – Oriented Modeling –Terminologies.

Software Requirements Elicitation and Analysis - Case Study: Library Management System- What is Software Requirement? – Requirements Elicitation Techniques – Initial Requirements Document- Use Case Approaches – Characteristics of a good Requirement- Software Requirements Specification Document - Requirements Change Management - Object Oriented Analysis - Structured Analysis versus Object Oriented Analysis – Identification of Classes – Identification of Relationships – Identification of State and Behavior – Overview of Cost Estimation Techniques.

Software Design - Object Oriented Design - What is done in object oriented design? – UML - Interaction diagram - Sequence diagram – Collaboration Diagrams - Refinement of Use Case Description – Refinement of classes and relationships - Identification of Operations to Reflect the implementation environment – Construction of Details class diagrams - Development of Details Design and Creation – Generating Test cases from User Cases – Object Oriented Design principles for Improving Software Quality.

Software Implementation - Quality and Metrics -Software Implementation – Tools and Techniques - What is software quality? – Software quality models - Measurement basic - analyzing the metric data - Metrics for measuring size and structure – Measuring software quality object oriented metrics.

Software Testing and Maintenance -What is software testing? – Software verification techniques – Checklist: a popular verification tool - Functional Testing – Structural Testing – Object Oriented Testing - Class testing – State based testing - Mutation testing - Levels of testing - Software testing tools - What is a software maintenance? - Categories –Challenges of software maintenance – Maintenance of Object oriented Software - Software rejuvenation - Estimation of maintenance efforts - Configuration management – Regression testing.

References:

1.Yogesh Singh, Ruchika Malhotra, "Object-Oriented Software Engineering", PHI, 2012.

2.Timothy C. Lethbridge and Robert Laganiere, "Object-Oriented Software Engineering", McGraw-Hill, 2001.

3.G. Booch, Benjamin/Cummings, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Addison-Wesley, 2007.

4. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw-Hill Higher Education, 2010.

Outcomes:

Students will be able to:

- *Practice the application principles of object-oriented software development and various CASE tools.*
- *Convey design decisions using UML.*

CAS755 PROJECT WORK –Phase I

To explore various research papers pertaining to chosen domain and arrive at a survey.

CAS757 FOSS LAB

To expose students to FOSS environment and introduce them to use and modify existing programs using open source packages/Technologies listed below:

1. Linux
2. Android/ Mozilla OS
3. GIMP: GNU Image Manipulation Program
4. Apache Struts
5. PHP
6. Python
7. Ruby
8. Apache Cassandra database
9. Mongo DB, NoSQL
10. Hadoop

CAS 799 PROJECT WORK –Phase II

Internal project work for 6 months duration with submission of thesis and viva-voce examination

Outcome: To publish a paper in conference or a journal.

ELECTIVES

CAS7A1 BIG DATA ANALYTICS

Objectives:

- *To get introduced to big data analytics and to understand the importance of big data.*
- *To get introduced with different approaches of exploiting big data sources such as social media, mobile devices and sensors through understanding methodologies of analyzing big data.*
- *To acquire knowledge of handling unstructured and semi-structured data using NoSQL database.*

Introduction: IT revolution, digital media, relationship among people, media and information, The fundamental structure of web, Social media as a platform, the framework of media, the paths of messages: transition and diffusion, Hadoop Framework.

Fundamentals: Search, Indexing and Memory, Handling Streams, Information and Language, Analyzing Sentiment and Intent, Databases and their Evolution, Big Data Technology and Trends, Different kinds of Analytics, Programming: Map-Reduce.

Communities: Observation and discrimination of the special crowds, (communities) living in the words of social media, methods and tools for identifying online communities (big data analytics), Clarifying the principles of embedding, concatenation and emergence operations in online society, Analysis of the different stages in the development of community.

NoSQL Databases: Evolution of Document Databases, Design and use of NoSQL databases, Storage and retrieval of unstructured data, NoSQL applications and query options, NewSQL.

Big Data Analytics: Classification, Clustering, and Mining, Information Extraction, Regression and Feature Selection, Reasoning: Logic and its Limits, Dealing with Uncertainty, Bayesian Inference, Forecasting, Neural Models, Deep Learning, and Research Topics.

References:

1. Philip (flip) Kromer and Dieterich Lawson, "Big Data for Chimps - A Guide to Massive-Scale Data Processing in Practice", O'Reilly Media, 2014.
2. Viktor Mayer-Schonberger and Kenneth Cukier, "Big Data: A Revolution That Will Transform How We Live, Work, and Think", Houghton Mifftlin Harcourt, 2013.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 2012.
4. "Beginner's guide to Big Data Analytics using R & Hadoop", online course, Jigsaw Academy Education Private Limited, 2012.

Outcomes

Students will be able to:

- *Comprehend the concepts of big data analytics.*
- *Build web-intelligence applications exploiting big data using new big data platforms based on the 'map-reduce' parallel programming framework.*
- *Effectively use NoSQL database for storage and retrieval of big data.*

CAS7A2 SOFT COMPUTING

***Objectives**:*

- *To introduce the techniques of soft computing.*
- *To explain the hybridization of soft computing systems.*
- *To distinguish between conventional AI and Soft Computing systems in terms of its tolerance to imprecision and uncertainty.*

Soft Computing and its Techniques, Soft Computing verses Hard Computing. Applications of Soft Computing in the current industry. Fuzzy Sets, Operations on Fuzzy sets, Fuzzy Relations, Fuzzy Measures, Applications of Fuzzy Set Theory to different branches of Science and Engineering.

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

NeuroFuzzy and Soft Computing, Adaptive Neuro-Fuzzy Inference System Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN. Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum. Hybridization of other techniques.

Genetic Algorithm, Fundamentals, basic concepts, working principle, encoding, fitness unction, reproduction, Genetic modeling: 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 methods. Hybrid Systems, Integration of neural networks, fuzzy logic and genetic algorithms.

Introduction to Swarm Intelligence and key principles (e.g., self-organization, stigmergy), natural and artificial examples, computational and embedded SI. From real to virtual ants: Ant System (AS), the first combinatorial optimization algorithm based on ant trail. Application to a classical operational research problem: the Travel Salesman Problem (TSP). Introduction to unsupervised multi-agent machine-learning techniques for automatic design and optimization: terminology and classification, Genetic Algorithms (GA) and Particle Swarm optimization (PSO). Comparison between both techniques in theory and practice.

References:

1. J.S.R.Jang, C.T.Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004.
2. J. Freeman and D. Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Addison-Wesley, 1991.
3. G. J. Klir and B. Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice-Hall, 1995.
4. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
5. Kennedy J. and Eberhart R. C. with Y. Shi, "Swarm Intelligence", Morgan Kaufmann Publisher, 2001.

Outcomes:
Students will be able to:

- *Implement soft computing algorithms.*
- *Model global optimization solutions for various real life problems.*

Industrial Component: A series of tutorials on MATLAB.

CAS7A3 COMPUTER SECURITY

Objectives:

- *To study the concepts and principles of Information Security.*
- *To understand the network principles, various security threats and the ways to overcome them effectively.*
- *To know the effectiveness of various network security toolkits.*

Computer Security Basics– Threats to Society - Risk Analysis - Basics of Access Control – Techniques – Administration – Accountability - Models –Identification and Authentication Methods - File and Data Ownership - Related Methods of Attacks

Common Security Principles - Security policy – Security Administration Tools - Physical Security - Personal Security - Computer Security Law - Goals of Cryptography - Cryptographic Algorithms - Digital Signatures - Digital Certificates - Steganography - Watermarking.

Internet Protocol Security (IPSec) - Web Security - Malicious Code - Types of Attacks - Firewall Security - Perimeter Security Devices -Types of Firewalls - Firewall Topologies - Firewall Rulebases

Operating System Security Terms and Concepts - System Security Threats -Keystroke Logging - Scanning and Foot printing - Antivirus Software - File System Security Issues – Checksums -System Logging Utilities

Network and Server Attacks and Penetration - Principles of Intrusion Detection Systems - Security Scanning - System Security Scanning and Discovery

References:

1. Matt Bishop, "Introduction to Computer Security", Addison Wesley, 2005.
2. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", 2nd Edition, Prentice Hall, 2007.
3. Dieter Gollmann, "Computer Security", 3rd edition, John Wiley and Sons Ltd, 2011.
4. Whitman and Mattord, "Principles of Information Security", 4th edition, Cengage Learning, 2011.

Outcomes:
Students will be able to:

- *Understand and anticipate information security issues and to suggest preventive measures.*
- *Design and execute penetration testing on a real computer network.*

CAS7B1 GPGPU PROGRAMMING

Objectives:

- *To introduce the features of massively parallel programming architecture.*
- *To utilize massively parallel computing capability of a GPU for high performance computing requirements.*
- *To provide an overview of parallel design patterns.*

Introduction: CPU Design – Latency Oriented, GPU Design – Throughput Oriented – Need to use both - Software Cost - Scalability, Portability, GPU Introduction and Architecture, History of GPU Computation, GPGPU Frameworks, Graphics Processor Architecture, Compute Capability, Drop-In Libraries, OpenACC Directives

Parallel Programming Patterns: Overview, Element Addressing - Multidimensional Kernel, Map, Gather, Scatter, Reduce, Scan, Thread Handling, Overview, Barrier Synchronization, Thread Synchronization Demo, Warp Divergence, Matrix Multiplication

CUDA Tools and APIs: Tools Overview, Using NSight Visual Studio and Eclipse, Running CUDA Apps, Debugging, Profiling, CUDA Architecture, CUDA APIs, CUDA 5.5 and 6 Features

CUDA programming: Overview, Compilation Process, Von Neumann Processor and CUDA Thread, Execution Model, First program in CUDA (Vector Addition), Location Qualifiers, Grid and Block Dimensions, Global Memory, Constant and Texture Memory, Shared Memory, Register and Local Memory, Data Movement, Error Handling, Device Introspection

Atomics: Overview, Need for Atomics, Atomic Functions, Atomic Sum, Monte Carlo Pi, Handling Events and Streams**,** Overview, Events, Event API, Event example, Pinned.

References:

1. D. Kirk and W. Hwu, "Programming Massively Parallel Processors – A hands-on approach", 2nd Edition, Morgan Kaufmann Publishers, 2010.
2. Thomas Rauber and Gudula Runger, "Parallel Programming for Multi-core and Cluster Systems", ACM Computing classification, 1998.
3. Shane Cook, "CUDA Programming - A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers, 2012.
4. Jason Sanders and Edward Kandrot, "CUDA by Example", Addison Wesley, 2010.

Outcomes:

Students will be able to:

- *Utilize massively parallel computing capability of a GPU.*
- *Solve High Performance Computing problems using GPUs.*

CAS7B2 IMAGE PROCESSING

Objectives:

- *To study and understand the image fundamentals and the mathematical models used to perform various operations on an image.*
- *To apply image processing techniques in real time applications.*

Introduction: The human vision system-Computer vision system-Mathematical system-image formation, sampling, quantization-Basic image processing operations: point operators, group operations, statistical operators.

Image transforms - Fourier, Discrete Fourier, Fast Fourier, Walsh, Hadamard, Discrete Cosine and Haar Transforms.

Fundamentals of Spatial filtering-Smoothing spatial filters-sharpening Spatial filters- Basics of filtering in Frequency Domain-Image smoothing using frequency domain filters-Image sharpening by frequency domain filters.

Image Restoration-Image Enhancement- Image Segmentation- Image Compression-Color Image Processing-Morphological image processing.

Representation and Description: Boundary descriptor, Regional descriptor, Relational descriptor-Object Recognition.

References:

1. Mark S. Nixon and Alberto S. Aguado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, Elsevier, 2012.
2. R. Gonzalez and R. E. Wood, "Digital Image Processing", 3rd Edition, Prentice Hall of India, 2008.
3. K.Pratt, "Digital Image Processing", 4th Edition, McGraw Hill, 2007.

Outcomes:

Students will be able to:

- *Apply fundamental algorithms in Image Processing and analyse their applicability for real time problems.*
- *Design solutions for various content based information retrieval problems.*
- *Understand the perception of human vision.*

CAS7B3 CRYPTOGRAPHY

Objectives:

- *To understand the principles of encryption algorithms: conventional and public key cryptography.*
- *To have a detailed knowledge about authentication, hash functions and application level security mechanisms.*

Introduction: Cryptography and modern cryptography – The setting of private-key encryption – Historical ciphers and their cryptanalysis – Basic principles of modern cryptography – Services, Mechanisms and Attacks – OSI security architecture.

Symmetric techniques: Definition – Substitution ciphers – Transposition ciphers - Stream and block ciphers - Characteristics of good ciphers - Data Encryption Standard (DES) Advanced Encryption Standard – Block cipher modes of operation.

Asymmetric techniques: Principles of Public Key Cryptosystems – The RSA Algorithm – Key Management – Diffie Hellman Key Exchange – Elliptic Curve Cryptography – over reals, prime fields and binary fields.

Message authentication: Authentication requirements – Authentication functions – Message Authentication Codes (MAC) – Hash functions – Security of hash functions and MACs, MD5 Message Digest Algorithm.

Implementing cryptographic algorithms: Tamperproof Query strings, Hashed Passwords, Salted Passwords, Crypto Stream, Web Site Encryption, Digital Signatures - Authentication Protocols - Digital Signature Standard (DSS), Digital Certificates, Key Sizes and Storage, SSL/TSL.

References:

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2010.
2. Ingemar J.Cox, Matthew L.Miller, Jeffrey A.Bloom, Jessica Fridrich and Ton Kalker, "Digital Watermarking and Steganography", Morgan Kaufmann Publishers, 2008.
3. William Stallings, "Cryptography and Network Security, Prentice Hall, 2006.
4. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, 2006.
5. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", Chapman & Hall/CRC, 2007.
6. Bruce Schneier, "Applied Cryptography", John Wiley & Sons, 2004.

Outcomes:

Students will be able to:

- *Understand fundamental techniques used in Cryptography.*
- *Decide upon the use of a particular cryptographic technique for a specific real time scenario.*

CAS 7C1 DESIGN PATTERNS

Objectives:

- *To comprehend the rationale and benefits of software design patterns.*
- *To impart knowledge on the development of good design patterns.*

Introduction: Introduction to Design Patterns, Object Oriented Analysis and Design, Types of Design Patterns, Applications of Design Patterns, Anti Patterns, Code Refactoring Techniques for design patterns

Creational Patterns: Factory Methods, Static Factory Pattern, Singleton Pattern, Abstract Factory Pattern, Object Pool Pattern, Prototype Pattern, Builder Pattern, Telescopic Constructor Pattern

Structural Patterns: Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Façade Pattern, Flyweight Pattern, Private Class Data, Proxy Pattern

Behavioral Design Patterns - I: Chain of responsibility Pattern, Command Pattern, Interpreter Pattern, Iterator Pattern, Mediator Pattern

Behavioral Design Patterns – II: Memento Pattern, Null Object Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template method, Visitor Pattern

References:

1. Gamma, "Design Patterns - Elements of Reusable Object-Oriented Software", Addison-Wesley, 1995.
2. Eric Freeman and Elisabeth Freeman, "Head First Design Patterns", O'Reilly, 2004.
3. Stephen Stelting and Olav Maassen, "Applied Java Patterns", Prentice Hall, 2002.
4. James W. Cooper, "Java Design Patterns - A Tutorial", Addison-Wesley, 2000.
5. Joshua Kerievsky, "Refactoring To Patterns", Addison-Wesley, 2005.

Outcomes:

Students will be able to:

- *Solve common problems in software design with ease.*
- *Represent design decisions more effectively with examples and architectural use cases.*

CAS 7C2 INTERNET OF THINGS

Objectives:

- *To understand the fundamentals of internet of things.*
- *To acquire skills to program the embedded devices and connecting them to the web and cloud.*

Internet of things: Overview, technology of the internet of things, enchanted objects, Design principles for connected devices, Privacy, Web thinking for connected devices

Writing Code: building a program and deploying to a device, writing to Actuators, Blinking Led, Reading from Sensors, Light Switch, Voltage Reader, Device as HTTP Client, HTTP, Push Versus Pull

Pachube, Netduino, Sending HTTP Requests—The Simple Way, Sending HTTP Requests—The Efficient Way

HTTP: Device as HTTP Server, Relaying Messages to and from the Netduino, Request Handlers, Web Html, Handling Sensor Requests, Handling Actuator Requests

Going Parallel: Multithreading, Parallel Blinker, prototyping online components, using an API, from prototypes to reality, business models, ethics, privacy, disrupting control, crowdsourcing

References:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons, 2013.
2. Cuno Pfister, "Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud", Maker Media, 2011.

Outcomes:

Students will be able to:

- *Program embedded devices.*
- *Program simple actuators and sensors.*
- *Build client programs that push sensor readings from a device to a web service.*

CAS7C3 CLOUD COMPUTING

Objectives:

- *To understand the various concepts of Distributed and Cloud computing.*
- *To study the Architecture and service models in Cloud computing.*

Distributed Systems Models and Enabling Technologies: Scalable Computing – Technologies for Network-Based Systems – System Models for Distributed and Cloud Computing – Software Environments for Distributed and Clouds – Performance, Security and Energy Efficiency

Virtualization concepts: Implementation Levels of Virtualization – Virtualization Structures - Tools and Mechanisms – Virtualization of CPU, Memory and I/O Devices – Virtual Clusters and Resource Management – Virtualization for Data-Center Automation, Introduction to Various Virtualization OS - VMware, KVM, Xen.

Service-Oriented Architecture for Distributed Computing: Services and SOA- Message oriented middleware– Portals and Science Gateways – Discovery-Registries-Metadata - Workflow in SOA

Cloud Computing and Service Models – Data-center Design and Interconnection Networks – Architectural Design of Compute and Storage Clouds – Public cloud Platforms – Inter-cloud Resource Management – Cloud Security and Trust Management

Cloud Programming and Software Environments – Features of Cloud and Grid Platforms – Parallel and Distributed Paradigms – Programming Support of Google App Engine – Amazon AWS and Microsoft Azure - Emerging Cloud Software Environments

References:

1. Kai Hwang, Geoffrey C.Fox, and Jack J. Dongarra,"Distributed and Cloud Computing", Elsevier India Private Limited, 2012.
2. Foster and Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", Morgan Kauffman publishers Inc.,2004
3. Coulouris, Dollimore and Kindber, "Distributed System: Concept and Design", Fifth Edition, Addison Wesley, 2011.
4. Michael Miller, "Cloud Computing", Dorling Kindersley India, 2009.
5. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, "Cloud computing: A practical Approach", McGraw Hill, 2010.

Outcomes:

Students will be able to:

- *Be aware of the features of Cloud Computing.*
- *Understand various performance criteria to evaluate the quality of the cloud architecture.*