

## Semester-I

**CST.501**

**Research Methodology and Statistics**

**Credit Hours: 4**

**Objective:** The objective of this course is to ensure that a student learns basis of scientific research and statistical methods to arrive at and verify the conclusions drawn.

### Unit I

**14 Hours**

**General Principles of Research:** Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion.

**Technical Writing:** Scientific writing, Writing synopsis, Research paper, Poster preparation, Presentations and Dissertation.

### Unit II

**14 Hours**

**General Statistics:** Difference between parametric and non-parametric statistics, Univariate and multivariate analysis, Confidence interval, Errors, Levels of significance, Hypothesis testing, Measures of central tendency and dispersal, Histograms, Probability distributions (Binomial, Poisson and Normal), Sampling distribution, Kurtosis and Skewness.

### Unit III

**14 Hours**

**Comparative Statistics:** Comparing means of two or more groups: Student's t-test, Paired t-test, One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Fisher's LSD (Least significant difference), Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test.

### Unit IV

**14 Hours**

**Regression and Correlation:** Standard errors of regression coefficients, Comparing two regression lines, Pearson Product – Moment Correlation Coefficient, Spearman Rank correlation coefficient, Power and sampling size in correlation and regression.

#### Text books:

1. Kothari, C.R. 2008. Research Methodology: Methods and Techniques. 2<sup>nd</sup> ed. New Age International.
2. Gall, J.P., Borg, W.R. and Gall, M.D. 2006. Educational Research: An Introduction. Prentice Hall.
3. Norman, G. and Streiner, D. 2008. Biostatistics: The Bare Essentials. 3/e (with SPSS). Decker Inc. USA.

#### Suggested readings:

1. William, W. 2009. Research Methods in Education. India: Pearson Education.
2. Best J. W. 1999. Research in Education, New Delhi: Prentice Hall of India Pvt. Ltd.

**CST.502**

**Advanced Data Structures and Algorithms**

**Credit Hours: 4**

**Objective:** This course will emphasize on advance data structures and algorithm analysis. Various problem solving techniques will be explained as a part of the course. This course will also help in detailed understanding of various data structures.

**Unit I** **14 Hours**

**Introduction to Algorithm Concepts:** Role of algorithms in computing, asymptotic notations, Algorithms design, Algorithm analysis.

**Data Structures:** Link Lists, Queues, Hash tables, Binary search trees, Red-black tree.

**Unit II** **14 Hours**

**Design Strategies:** Divide-and-conquer, Dynamic Programming, Greedy Method.

**Sorting & Searching Algorithms:** Sorting, Sorting algorithms: Radix sorting, Heap sort, Quick sort, Counting Sort, Search algorithms: linear search and binary search algorithm.

**Unit III** **14 Hours**

**String Matching Algorithms:** The naive string-matching algorithm, Rabin-Karp, String matching with finite automaton, Knuth-Morris-Pratt.

**Advanced Data Structure:** B trees, Fibonacci Heaps, Data structures for disjoint sets.

**Unit IV** **14 Hours**

**Graph Algorithms:** Elementary graph algorithms, Minimum spanning trees, shortest path algorithms: single source and all pair, Max flow problem and its solutions.

**Online Algorithms:** Introduction Online Algorithms, Online Paging Problem. Algorithms used by search engines, and routers.

**Text books:**

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C. 2009. Introduction to Algorithms.3<sup>rd</sup>ed. Mit Press.
2. Lipschutz, S. 2009. Data Structures with C. Tata McGraw-Hill Education.
3. Tenenbaum, A. M. 2009. Data Structures Using C. Pearson Education India.

**Suggested readings:**

1. Aho, A.V., Hopcroft, J.E. and Ullman, J. D. 2009. Data Structures and Algorithms. India: Pearson Education.
2. Horowitz, E., Sahni, S. and Rajasekaran, S. 2010. Fundamentals of Computer Algorithms. Galgotia Publications.
3. Weiss, M.A. 2009. Data Structures and Algorithm Analysis in C++. India: Pearson Education.

**CST.503**

**Advanced Computer Networks**

**Credit Hours: 4**

**Objective:** The course is structured to uncover and understand the current directions of computer networks from literature readings and to encourage a performance perspective towards analysis of computer and communications networks. Topics are covered in some depth, including both abstract and concrete aspects. The Emphasis of course is on various advanced

internetworking and routing techniques. It helps to “fill-in” gaps in students’ networking knowledge.

**Unit I** **14 Hours**

**Review of Computer Networks, Devices and the Internet:** Internet, Network edge, Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, Networking and Internet - Foundation of Networking Protocols: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing. Multiplexers, Modems and Internet Access Devices, Switching and Routing Devices, Router Structure.

**Unit II** **14 Hours**

**The Link Layer and Local Area Networks-**Link Layer, Introduction and Services, Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches.

**Local and personal Area Networks:** IEEE802.3 Ethernet, IEEE 802.11 and WLANs, IEEE 802.16 (WiMax), IEEE 802.15 Wireless Personal Area Networks: IEEE 802.15.3-A Ultra Wideband Wireless Personal Area Networks, IEEE 802.15.4 ZigBee.

**Unit III** **14 Hours**

**Routing and Internetworking:** Network–Layer Routing, Intra-domain Routing Protocols, Inter-domain Routing Protocols, Congestion Control at Network Layer. Logical Addressing: IPv4 Addresses, IPv6 Addresses - Internet Protocol: Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Security problems with Internet Architecture,

**Multicasting Techniques and Protocols:** Basic Definitions and Techniques, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, Mobility in networks. Voice and Video over IP (RTP, RSVP, QoS).

**Unit IV** **14 Hours**

**Transport and Application Layer Protocols:** Client-Server and Peer-To-Peer Application Communication, Protocols on the transport layer, reliable communication. Routing packets through a LAN and WAN. Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control. Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server.

**Text books:**

1. Beasley, J. S. and Nilkaew, P. 2012. A Practical Guide to Advanced Networking. 3<sup>rd</sup> ed. Pearson Education.
2. Trivedi, B. 2013. Computer Networks. Oxford University Press.
3. Kurose, J. F. and Ross, K. W. 2010. Computer Networking – A top-down approach featuring the Internet, 3<sup>rd</sup> Ed. India: Pearson Education.

4. Olifer, N. and Olifer, V. 2012. Computer Networks: Principles, Technologies and Protocols for Network Design. India: John Wiley & Sons.
5. Forouzan, B.A., 2009, Data Communications and Networking, 4<sup>th</sup> Ed. Tata McGraw Hill Education.
6. Tenenbaum, A. S., Wetherall, D. 2011. Computer Networks. 5<sup>th</sup> ed. Pearson Prentice Hall.

**Suggested readings:**

1. Peterson L.L. and Davie B.S. 2011. Computer Networks: A System Approach, 5<sup>th</sup> Ed. India: Elsevier.
2. Comer, D. E. and Narayanan, M. S. 2012. Computer Networks and Internets: with Internet Applications, 4<sup>th</sup> Ed. India: Pearson Education.
3. Pahlavan, K. and Krishnamurthy, P. 2009. Networking Fundamentals: Wide, Local and Personal Area Communications. India: John Wiley & Sons.
4. Loo, J., Mauri, J. L. And Ortiz, J. H. 2012. Mobile Ad-hoc Networks: Current Status and Future Trends. CRC Press, USA: Taylor & Francis Group.
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**CST.504**

**Advanced Software Engineering**

**Credit Hours: 4**

**Objective:** To apply principles of software development and evolution. To specify, abstract, verify and validate solutions to large-size problems, to plan, develop and manage large software and learn emerging trends in software engineering. This course aims to give students a theoretical foundation in software engineering. Students will learn about the principles and methods of software engineering, including current and emerging software engineering practices and support tools.

**Unit I**

**14 Hours**

**Introduction:** Software Engineering, Software Process Models: SDLC, Waterfall Model, Incremental Model, Prototyping Model, Evolutionary Model, Spiral Model, Rapid Application Development Model, Scheduling, Project Estimation Techniques, Empirical Estimation Techniques, Software Project Planning.

**Software Requirements Analysis & Specification:** Functional and non-functional Requirements, Software Requirements Document, Requirements Specification, Requirements Engineering Process, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management.

**Unit II**

**14 Hours**

**Software Quality:** Quality Concepts, Quality Control, Quality Assurance, Cost of Quality, SQA Activities, Software Reviews, Formal Technical Reviews, Software Reliability, Software Safety, ISO Approaches to Quality Assurance Systems.

**Software Configuration Management:** SCM Process, Identification of Objects in Software Configuration, Version Control, Change Control, Configuration Audit, SCM Standards.

**Unit III**

**14 Hours**

**Software Design:** Design Concepts, Function Oriented Design, Object Oriented Design, Architectural Design, User Interface Design, Component Level Design, Complexity Metrics.

**Coding & Software Testing:** Programming Principles, Incrementally Developing code, Managing Evolving code, Testing process, Software test case design techniques- Black box testing, white box testing, Unit testing, Integration Testing, Validation Testing, System Testing, Debugging.

**Unit IV**

**14 Hours**

**Software Maintenance and Reuse:** Characteristics of Software Maintenance, Software Maintenance Process Models, Software Reuse Approach.

**Clean Room Software Engineering:** Cleanroom Approach, Functional Specification, Cleanroom design, Cleanroom Testing.

**Component Based Software Engineering:** Engineering of component Based Systems, CBSE Process, Component Based Development

**Computer Aided Software Engineering:** CASE, Building Blocks of CASE, Taxonomy of CASE Tools, CASE Repository.

**Reengineering:** Software Reengineering, Reverse Engineering, Restructuring, Forward engineering.

**Text books:**

1. Sommerville, I. Software Engineering. 9<sup>th</sup> Edition. Pearson Education.
2. Pressman, R.S. Software Engineering: A Practitioner's Approach, Sixth Edition. McGraw Hill.
3. Mall, R. Fundamentals of Software Engineering, Third Edition, Prentice Hall of India.
4. Jalote, P. An Integrated Approach to Software Engineering, Second Edition. Wiley India
5. Aggarwal, K.K. and Singh, Y. Software Engineering, Second Edition. New Age International.

**CST.505**

**Advanced Data Structures and Algorithms- Lab**

**Credit Hours: 2**

Students should be asked to implement the algorithms/programs in C++:

- WAP to simulate various sorting and searching algorithms.
- WAP to create a linked List and perform operations such as insert, delete, and reverse.
- WAP to implement Binary search tree.
- WAP to simulate various Graph traversing techniques.
- WAP to compute the shortest path of a graph using Dijkstra's algorithm
- WAP to find the minimum spanning tree using Prim's and Krushkal's Algorithm
- WAP to implement Knuth-Morris-Pratt algorithm for pattern matching.
- Any program related to the subject.

**CST.506****Advanced Computer Networks- Lab****Credit Hours: 2**

In this practical class students should be asked to implement following scenarios in (Opnet/NS-2/ NS-3) network simulator:

- Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
- Study of Network Devices in Detail.
- Connect the computers in Local Area Network.
- Study of basic network command and Network configuration commands.
- Introduction and installation of Network Simulator.
- Simulate a three nodes point-to-point network with duplex links between them. Set the queue size vary the bandwidth and find the number of packets dropped.
- To create Output files for analyzing and plotting received traffic/data.
- Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets by TCP/UDP.
- Simulate the different types of Internet traffic such as FTP a TELNET over a network and analyze the throughput.
- Simulate the transmission of ping messaged over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
- Simulate an Ethernet LAN using N-nodes(6-10) by varying data rate and compare the throughput.
- Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and determine collision across different nodes.
- Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source/destination.
- Any program related to the subject.

**CST.507****Seminar-I****Credit Hours: 2**

The students should be asked to give seminar on advanced topic/case study/technology/tool in the field of Computer Science. The purpose of the seminar is to judge the knowledge of the students in field of Computer Science and to discuss current trends in the field.

## Interdisciplinary Electives-I

**CST.508**

**Computer Applications**

**Credit Hours: 2**

**Objective:** Objective of this course is to provide the basic understanding about the working of computer and application softwares.

**Unit I** **7 Hours**

**Fundamentals of Computers:** Parts of computers, Hardware, BIOS, Operating systems, Binary system, Logic gates and Boolean Algebra. Introduction to computer network and World Wide Web.

**Unit II** **7 Hours**

**MS-Word:** Introduction to Word Processing, Creating and Saving Documents, Text Formatting, Tables, Document Review Option, Mail Merge, Inserting Table of Contents, Reference Management.

**Unit II** **7 Hours**

**Applications Software:** Introduction to MS Paint, Notepad, Spreadsheet applications, Presentation applications, Internet browsers and Image processing applications.

**Unit IV** **7 Hours**

**World Wide Web:** Origin and concepts, Latency and bandwidth, Searching the internet, Advanced web-search using Boolean logic, Networking fundamentals.

**Text books:**

1. Gookin, D. 2007. MS Word for Dummies. Wiley.
2. Harvey, G. 2007. MS Excel for Dummies. Wiley
3. Sinha, P.K. Computer Fundamentals. BPB Publications.
4. Bott, E. 2009. Windows 7 Inside Out. Microsoft Press.
5. Goel, A., Ray, S. K. 2012. Computers: Basics and Applications. Pearson Education India.

**CST.509**

**Internet Basics and its Security**

**Credit Hours: 2**

**Objective:** The objective of this course is to explore the types of security being used to support applications and services on the Web.

**Unit I** **7 Hours**

**Introduction to the Internet and the Web:** Basic of Computer networks: LAN, WAN, Introduction to Internet, Types of Internet Connection, WiFi, Hotspots, Internet Stick, Mobile devices, etc., Common password mistakes, Tips for creating strong passwords.

**Information on the Internet:** Introduction to search engines.

**Unit II** **7 Hours**

**Basic Parts of the Web Browser Window:** Address bar, search bar, back and forward button, scroll bars, Tool bars.

**Key Web Browser Features:** Create and organize favorites, Changing home page, delete browsing history and cookies, How to increase the security of a browser, Identify when you are on a secure website, How to view and use history, Pop up blockers. Browser security, Security threats and their identification.

**Websites:** WWW, Web-sites, Web servers, Web clients, URL, domain name (definition, name format), static websites, dynamic websites, Protocols (HTTP, HTTPS).

**Unit III** **7 Hours**

**Email Basics:** Email system, Differences between webmail and POP accounts, Creating address book/contact list, basic formatting, How to block messages, How to filter/redirect messages, Reporting Spam. **Organizing Email:** sorting of messages: date, size, sender, Managing Emails in Outlook Express.

**Email Security and Countermeasures:** E-mail Threats: Email Spoofing, Email Scams and countermeasures, Email Bombing, Preventing Spam Mails.

**Classes of Attack:** Stealing Passwords, Social Engineering, Bugs and Backdoors, Authentication Failures, Information Leakage. Viruses (Types of Virus, Symptoms of Virus infection, Sources of Virus) and Worms, Denial-of-Service Attacks, Active Attacks. **Antivirus Programs** - Introduction, Ensure they are updated, Use of Antivirus.

**Unit IV** **7 Hours**

**E-Commerce:** Introduction, elements of E-Commerce, Business to business and business to consumer E-Commerce, Phishing: phishing attacks, symptoms and preventive measures.

**Internet and Web Security :** Overview of internet Security, Aspects and need of Security Web security and privacy concepts, Firewalls, Cryptography, Authentication, Authorization and Access Control, Copyright issues, Internet Security and management Concepts.

**Text books:**

1. ISRD. Internet Technology and Web Design. Tata McGraw-Hill Education.
2. Whiteley. 2008. E-Commerce: Strategy, Technologies and Applications. Tata McGraw-Hill Education.

**Suggested readings:**

1. Curtin. 2008. Information Technology. Tata McGraw-Hill Education.

**CST.510** **Programming in C** **Credit Hours: 2**

**Objective:** To Understand the Programming Fundamentals and the basics of the 'C' Programming Language.

**Unit I** **7 Hours**

**Introduction to Programming Language:** Types of Programming Language, Structured Programming, Algorithms and Flowcharts, Programming Language.

**Introduction to C:** History, Character Set, Structure of a C Program – constants, variables and Keywords, data types, expression statements, compound statements.

**Unit II** **7 Hours**

**C Operators:** Arithmetic, Unary, Relational and Logical, Assignment, Conditional Operator, Increment, decrement Operator, Using library function in math.



**Data Input Output:** Single character input, getchar, getch, getc, single character output putchar, putc, Formatted I/O.

**Unit III** **7 Hours**

**C Constructs:** If statement, while statement, do...while statement, for statement, switch statement, nested control statement, break, continue, goto statement.

**C Functions:** Functions, Definiton and scope, Assessing and Prototyping, Types of functions, Passing arguments to functions.

**Unit IV** **7 Hours**

**Arrays and Strings:** Single dimensional array, Multi-dimensional array, Initializing array using static declaration, character array and strings, String Handling functions.

**Text books:**

1. Rajaraman, V. 2008. Computer Basics and C Programming PHI Learning.
2. Brown, T. D. C for Basic Programmers Silicon Press.
3. Kanetkar, Y. P. 2010. Let Us C.12<sup>th</sup> ed. BPB Publications.
4. Balagurusamy. 2008. Programming in ANSI C. Tata Mcgraw-Hill.

**CST.511** **Operating System Basics** **Credit Hours: 2**

**Objective:** This course is designed to provide the basic understanding and experiential learning of operating system. The course also provides overview of Microsoft Windows and Linux based operating systems.

**Unit I** **7 Hours**

Computer Software Hierarchy, Memory Hierarchy, Introduction to Operating System, OS services and Components, Operating System types. Multitasking, Multiprogramming, Timesharing.

**Unit II** **7 Hours**

Introduction to Disk Operating System, DOS Internal and External Commands. Introduction to Microsoft Windows based Operating System, Windows terminology, Shortcuts for various operations, File and Directory Management,

**Unit III** **7 Hours**

Sharing Documents over network, Introduction to domains, Overview of Windows-7 and Window-8, Changing System Date and Time, Changing Display Properties, Adding and Removing Printers.

**Unit IV** **7 Hours**

Introduction to Linux based operating Systems, Basic features, Advantages, File System, Commands, Overview of Ubuntu Linux, Network Configuration in Ubuntu. Application Utilities available in Ubuntu, Introduction to bash and bash scripting.



**Text books:**

1. Davis,G. H. 2010. Beginning Microsoft Office 2010. Apress.
2. Beskeen,D. 2013.Microsoft Office 2013: Illustrated Introductory, First Course. Cengage Learning.

**Suggested readings:**

1. Shelly, G. and Vermaat, M. 2010.Microsoft Office 2010: Introductory. Cengage Learning.

## SEMESTER- II

CST.513

Advanced Database Management Systems

Credit Hours: 4

**Objective:** The course is intended to provide with an understanding and solid technical overview of the database management systems.

**Unit I** **14 Hours**

**Introduction:** File-Systems, database Approach, Database Environment, Database Languages, Data Models and Conceptual Modelling, Multi-user DBMS architecture, Relational Model and Languages: Relational Algebra and Calculus, SQL, Query-by-Example; Entity-Relationship Modeling, Enhanced Entity-Relationship Modeling, Normalization, Advanced Normalization.

**Unit II** **14 Hours**

**Database Issues:** Database Security: Threats, Countermeasures, DBMS and Web Security; Transaction Management, Concurrency Control: Serializability & Recoverability, Locking Methods, Timestamping Methods; Database Recovery: Recovery Facilities and Techniques; Query Processing, Query Decomposition, Query Optimization.

**Unit III** **14 Hours**

**Distributed and Parallel DBMS:** Distributed Database Concepts: Distributed Relational Database Design, Transparencies, Date's Twelve Rules, Distributed Transaction Management, Distributed Concurrency Control, Distributed Database Recovery, Distributed Query Optimization, Database Replication; Parallel DBMS Concepts: Inter-query and Intra-query Parallelism, Interoperation and Intra-operation Parallelism.

**Unit IV** **14 Hours**

**Object DBMS:** Object-oriented Concepts, Object-oriented Database Design, Object-oriented Data Models, Object-oriented DBMSs, Issues in OODBMSs.

**Data Warehousing and Data Mining:** Evolution of Data Warehousing, Architecture, Data Flows, Tools & Technologies, Data Marts, Data Mining: Concepts, Techniques, Process, Tools.

### Text books:

1. Connolly, T. and Begg, C. 2012. Database Systems, 4<sup>th</sup> Ed. India: Pearson Education.
2. Silberschatz, A. and Korth, H. F. and Sudarshan, S. 2011. Database System Concepts, 6<sup>th</sup> Ed. McGraw Hill.
3. Desai, B. C. 2010. An Introduction to Database Systems. Galgotia Publications.

### Suggested readings:

1. Date, C. J., Kannan, A. and Swamynathan, S. 2012. An Introduction to Database Systems, 8<sup>th</sup> Ed. India: Pearson Education.
2. Elmars, R. and Navathe, S. B. 2013. Fundamentals of Database Systems, 5<sup>th</sup> Ed. India: Pearson Education.

**CST.514**

**Wireless LAN and Mobile Computing**

**Credit Hours: 4**

**Objective:** The main objective of this course is to provide the students with the competences required for understanding and using the communications component of communications environment and to acquaint the students with basic knowledge and concepts of Wireless Data Transmissions.

**Unit I**

**14 Hours**

**Introduction:** History of Wireless Communications, Advantages of Wireless Communication, Disadvantages of Wireless communication, Wireless Network Generations, Comparison of Wireless Systems, Applications of Wireless Communications

**Wireless Communication Technology:** Signal Encoding Techniques, Overview of Modulation Techniques, Multiple Access Techniques.

**Unit II**

**14 Hours**

**Wireless Networks:** Cellular Wireless Networks, Cordless Systems, Paging and Wireless Systems, GSM: GSM Network Architecture, GSM Signalling Protocol Architecture, GSM Channels, IEEE standards for wireless networks: Wi-Fi, Bluetooth, WiMax.

**Wireless Internet:** Mobile IP components, process of agent discovery, registration and de-registration, care-of-address, concept of tunnelling, Limitations of Mobile IP, Wireless Application Protocol: WAP Introduction, Protocol Architecture, Components of WAP.

**Unit III**

**14 Hours**

**Mobile Computing:** Mobile communication, Mobile computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Mobility Management.

**Mobile Network Layer:** Mobile IP: Goals, Assumptions, Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol (DHCP)

**Unit IV**

**14 Hours**

**Mobile Transport Layer:** Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP, TCP over 2.5G/3G Wireless Networks.

**Text books:**

1. Schiller, J. 2008. Mobile Communications. 2nd ed. India: Pearson Education.
2. Kumar, S., et al. Wireless and Mobile Networks: Concepts and Protocols. Wiley India.
3. Kamal, R. Mobile Computing. Oxford University Press.

**Suggested readings:**

1. Talukder, K A., et al. 2008. Mobile Computing, Tata McGraw Hill.

2. Gast S.M., 802.11 Wireless Networks, SPD O'REILLY.
3. Stojmenovic I. 2007, Handbook of Wireless Networks and Mobile Computing, Wiley.
4. Rappaport, T.S. 2009. Wireless Communications. 2nd ed. India: Pearson Education.
5. Stallings, W. 2009. Wireless Communications & Networks. India: Pearson Education.
6. Singhal, T L. 2010 Wireless Communication Tata McGraw-Hill Education.

**CST.515**

**Information and Network Security**

**Credit Hours: 4**

**Objective:** The main objective of this course is to provide students with an overall understanding of the main concepts of information systems, cryptographic techniques and network security tools and to highlight the importance in modern organizations. It also gives an insight into the design and working of different cryptographic methods.

**Unit I** **14 Hours**

**History of Information Systems:** Importance of Information Systems, Basics of Information Systems, Changing Nature of Information Systems, Global Information Systems.

**Essential Security Terminologies:** Hardware, Software, Malware, Defining Security, Need for Security, Cyber-Crime Vs Computer Based Crime, Challenges for information security, Three Pillars of Security, Security Myths.

**Unit II** **14 Hours**

**Encryption and Decryption:** Attackers and Types of Threats, Encryption Techniques, Classical Cryptographic Algorithms: Monoalphabetic Substitutions such as the Caesar Cipher, Cryptanalysis of Monoalphabetic ciphers, Polyalphabetic Ciphers such as Vigenere, Vernam Cipher, Stream and Block Ciphers.

**Symmetric Key Systems:** Data encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Security of DES, Advance Encryption Standard (AES).

**Unit III** **14 Hours**

**Key Management Protocols:** Solving Key Distribution Problem, Diffie-Hellman Key Exchange Algorithm, Authentication Protocols.

**Public Key Encryption Systems:** Concept and Characteristics of Public Key Encryption System, Rivest-Shamir-Adleman (RSA) Encryption, Introduction to Digital Signatures: digital Signature, The Digital Signature Standard (DSS), SSL/TLS, Privacy Mechanisms.

**Hash Algorithms:** Hash concept, Description of Hash Algorithms.

**Unit IV** **14 Hours**

**Trojans and Backdoors:** Working of Trojans, Different Types of Trojans, Different ways a Trojan can get into a system, Indications of a Trojan Attack. Session Hijacking

**Network Security:** Security vulnerabilities at different layers, Intrusion Detection System, Firewalls, DMZs, Virtual Private Networks, IPSec Secure Communication Mechanism.

#### **Text Books**

1. Godbole, N. 2009. Information Systems Security: Security Management, Metrics, Frameworks and Best Practices. 1<sup>st</sup> Ed. John Wiley & Sons India.
2. Forouzan, B.A. 2010. Cryptography & Network Security. Tata McGraw-Hill Education.

3. Stallings, W. 2007. Network Security Essentials: applications and standards. 3<sup>rd</sup> ed. Pearson Education India.
4. Stallings, W. 2014. Cryptography and Network Security: Principles and Practice. 6<sup>th</sup> ed. Pearson.
5. Kahate, A. 2009. Cryptography and Network Security. McGraw-Hill Higher Ed.

**Suggested readings:**

1. Kim, D., and Solomon, M. G. 2010. Fundamentals of Information Systems Security. Jones & Bartlett Learning.
2. Cheswick, W. R. and Bellovin, S. M. 2003. Firewalls and Internet Security. 2<sup>nd</sup> Edition. Addison-Wesley Professional.

**CST.516**

**Digital Image Processing**

**Credit Hours: 4**

**Objective:** The Objective of this course is to ensure that a student learns the fundamentals of digital image processing, starting from image capturing to image enhancement, restoration and compression.

**Unit I** **12 Hours**

**Introduction:** Fundamental steps in Image Processing System, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels, Color Fundamentals, Color Models, Color Transformations.

**Unit II** **15 Hours**

**Image Enhancement Techniques:** Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters, Smoothing and sharpening filters, Homomorphism filtering.

**Image Restoration & Reconstruction:** Model of Image Degradation/restoration process, Noise models, Spatial filtering, Inverse filtering, Minimum mean square Error filtering, constrained least square filtering, Geometric mean filter, Image reconstruction from projections.;

**Unit III** **15 Hours**

**Image Compression:** Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Vector quantization, Entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

**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,

**Unit IV** **14 Hours**

**Image Segmentation:** Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, Watersheds; Introduction to morphological operations; binary

morphology- erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.

**Digital Image Watermarking:** Introduction, need of Digital Image Watermarking, applications of watermarking in copyright protection and Image quality analysis.

**Text books:**

1. Gonzalez, R.C. and Woods, R.E. 2009. Digital Image Processing. 2<sup>nd</sup> ed. India: Person Education.
2. Pratt, W. K. 2001. Digital Image Processing. John Wiley.
3. Jayaraman, S., Veerakumar, T. and Esakkiranjan, S. 2009. Digital Image Processing. Tata Mcgraw-Hill.

**CST.517**

**ADBMS Lab**

**Credit Hours: 2**

Students will be performing following practicals in ADBMS Lab:

- Execute a single line and group functions for a table.
- Execute DCL and TCL Commands.
- Create and manipulate various DB objects for a table.
- Create views, partitions and locks for a particular DB.
- Write PL/SQL procedure for an application using exception handling.
- Write PL/SQL procedure for an application using cursors.
- Write a DBMS program to prepare reports for an application using functions.
- Write a PL/SQL block for transaction operations of a typical application using triggers.
- Write a PL/SQL block for transaction operations of a typical application using package.
- Design and develop an application using any front end and back end tool (make use of ER diagram and DFD).
- Create table for various relations.
- Implement the query in SQL for a) insertion b) retrieval c) updation d) deletion.
- Creating Views.
- Writing Triggers.
- Implementing operation on relation using PL/SQL.
- Creating Forms.
- Generating Reports.
- Any program related to the subject.

**CST.518**

**Information and Network Security- Lab**

**Credit Hours: 2**

In this practical session students should be asked to implement the following lab exercises using C/C++/Java:

- Implement a program for Caesar, Playfair, Vigenere, Vernam Cipher.
- Implement a program for DES algorithm.
- Implement a program for RSA Algorithm.



- Implement a program for Diffie–Hellman key exchange algorithm.
- Enable to take access other’s computer by cracking password.
- Examine how sniffing software like Wire shark works.
- Examine how NMAP software works.
- Write a program to implement virus program.
- Install Rootkits and study variety of options.
- Any program related to the subject.

**CST.519**

**Research Seminar**

**Credit Hours: 2**

The student shall have to write his synopsis including an extensive review of literature with simultaneous identification of scientifically sound (and achievable) objectives backed by a comprehensive and detailed methodology. The students shall also present their synopsis to the synopsis approval committee.

The Evaluation criteria will be as detailed below:

| <b>Evaluation Parameter</b>                               | <b>Maximum Marks</b> |
|---|----------------------|
| Review of literature                                      | 10                   |
| Identification of gaps in knowledge and Problem Statement | 15                   |
| Objective formulation & Methodology                       | 15                   |
| Presentation  | 10                   |
| <b>Total</b>  | <b>50</b>            |

**Interdisciplinary Electives-II**

**CST.520**

**Digital Logic**

**Credit Hours: 2**

Objective: This course covers the basic working of the hardware. By covering this course students would get familiar about how hardware is designed for a particular operation.

**Unit I** **7 Hours**

**Introduction:** Digital Signals, basic digital circuits: AND operation, OR operation and NOT operation.

**Number Systems:** Introduction, Binary number system, Octal number system, Hexadecimal Number system, Conversion of one number system to other, Gray code.

**Unit II** **7 Hours**

**Logic Gates and Boolean Algebra:** Boolean Laws, Boolean expression and functions, Logic Gates.

**Unit III** **7 Hours**

**Combinational Circuit Design:** Karnaugh Map representation of logic functions, SOP, POS, Simplification of logic functions using K-Map.

**Unit IV** **7 Hours**

**Flip-Flops:** 1-bit memory cell, S-R Flip Flop, J-K Flip Flop, D- Flip Flop, T- Flip Flop.

**Text books:**

1. Mano, M. and Charles, K. (2007). Logic and Computer Design Fundamentals 4<sup>th</sup> ed. Pearson Education.
2. Jain, R.P. (2006). Modern Digital Electronics 3<sup>rd</sup> edition, Tata Mcgraw Hill.
3. Kharate, G.K. 2010. Digital Electronics. Oxford Higher Education.

**CST.521** **Multimedia and Its Applications** **Credit Hours: 2**

**Objective:** To get the Knowledge about the basics concepts of multimedia and its applications and also to get the knowledge of its relevance with internet and its future aspects.

**Unit I** **7 Hours**

**Introductory Concepts:** Multimedia-Definitions, Basic properties and medium types. Multimedia applications, Uses of Multimedia, the requirements to make good multimedia.

**Sound/ Audio:** Basic Sound Concepts, Music. **Speech:** Generation, Analysis and Transmission.

**Unit II** **7 Hours**

**Images and Graphics:** Basic concepts: Image representation, image format, Graphics Format, Computer Image Processing.

**Video and Animation:** Basic Concepts: Video Signal Representation, Computer Video Format. Television: Conventional Systems, Enhanced Definition Systems, High-Definition Systems, Transmission. Basics of Computer Based Animation.

**Unit III** **7 Hours**

**Data Compression:** Storage space, coding requirements, JPEG, MPEG.

**Miscellaneous:** Optical Storage Media, Multimedia Operating Systems, Multimedia Communication Systems.

**Unit IV** **7 Hours**

**Documents and Hypertext:** Document Architecture, Manipulation of Multimedia Data, Hypertext, Hypermedia and Multimedia and example.

**Multimedia Applications:** Media Preparation, composition, Integration, communication, Consumption, and Entertainment. Multimedia future directions.

**Text books:**

1. Steinmetz, R. 2009. Multimedia: Computing Communications & Applications. Pearson Education India.
2. Vaughan, T. 2008. Multimedia: making it work. Tata McGraw-Hill Education.

### Suggested readings:

1. Rao, K.R., Bojkovic, Z. S. and Milovanovic, D. A. 2002. Multimedia Communication Systems: Techniques, Standards, and Networks. Prentice Hall.
2. Andleigh, P.K. 2007. Multimedia Systems Design. Prentice Hall
3. Rimmer, S. 2007. Advanced Multimedia Programming. Windcrest/McGraw-Hill.

### CST.522                      Basics of Computer Networks                      Credit Hours: 2

**Objective:** To allow students to develop background knowledge in networking technologies. To study about network components, topologies and network models.

#### **Unit I** **7 Hours**

**Basic Concepts:** Components of data communication, Network classifications-LAN, MAN, WAN, Data and signals-analog and digital, Data communication protocols and standards.

**Network Models:** OSI model-layers and their functions. TCP/IP protocol suite.

#### **Unit II** **7 Hours**

**Transmission Media:** Guided Media: Twisted pair cable, coaxial cable, fiber optic cable, Unguided Media: radio waves, micro waves, infrared.

**Transmission Modes:** Serial Transmission, Parallel Transmission.

**Switching:** Message, Circuit and Packet Switching.

#### **Unit III** **7 Hours**

**Multiple Access:** Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing, Channelization: FDMA, TDMA, CDMA.

#### **Unit IV** **7 Hours**

**Devices:** Repeaters, bridges, gateways, routers, The Network Layer, Design Issues, Network Layer Addressing and Routing concepts.

**Wired LANs:** Ethernet: IEEE standards, standard Ethernet- fast Ethernet. Wireless LANs: IEEE 802.11.

#### **Text books**

1. Frouzan, A B. 2007. Data Communication and Networking. Huga Media.
2. Tomasi, W. 2007. Introduction to Data Communications and Networking. Pearson Education.
3. Tenenbaum, A. S., Wetherall, D. 2011. Computer Networks. 5<sup>th</sup> ed. Pearson Prentice Hall.

### CST.523                      Free and Open Source Software Tools                      Credit Hours: 2

**Objective:** The course explains fundamentals of open source technologies and licenses. The course also demonstrates the use of free and open source tools in research and teaching activities.

**Unit I** **7 Hours**

**Introduction:** Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, Income-generation opportunities, Problems with traditional commercial software, Advantages of Open Source, GNU General Public License (GPL) version 2,3, GNU Lesser General Public License (LGPL) version 2.1,3, GNU Affero General Public License (AGPL) version 3, Apache License, Version 2.0, Artistic License 2.0, etc.

**Unit II** **7 Hours**

**The Open Source Platform:** Operating Systems, Introduction to Linux, Linux Distributions, Linux Graphical Desktop. Command Line: Basic File System Management Task, Working with files, Piping and Redirection, Working with VI editor

**Unit III** **7 Hours**

**Introduction to Open Office:** Word Processing, Spreadsheets, Presentation applications in open office, Installing OpenOffice. Libre Office, Working with Latex.

**Unit IV** **7 Hours**

**Version Management with Repository Management Systems, Moodle:** creating MCQ tests using Moodle, RSINK: for backup, Mendelay& : Reference Management, TomBoy: to manage notes,

**Text books:**

1. Fadi P. Deek and James A. M. McHugh. Open Source Technology and Policy. Cambridge University Press.
2. Andrew M. St. Laurent. Understanding Open Source and Free Software Licensing. O'Reilly Media.

**Suggested readings:**

1. Soyinka, W. Linux Administration- A beginner's Guide. Tata McGraw Hills.
2. Woods, D., Guliani, G. Open Source for the Enterprise. O'Reilly Media.

**CST.524** **Introduction to Database** **Credit Hours: 2**

**Objective:** This course is designed to provide introductory hands-on learning using Microsoft Access in the Windows environment.

**Unit I** **7 Hours**

**Introduction: Necessity of a Database:** Characteristics of database -Database management systems - Types of database management systems - Logical data models - Hierarchical model Network model - Relational model - Object-oriented model – Object relational model Deductive/inference model - Comparison between various database models.

**Unit II** **7 Hours**

**Database Design and ER Model:** overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Cod's rules, Relational database model: Logical view of data, keys, integrity rules; Relational Database design: atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).

**Unit III** **7 Hours**

**MS Access:** Introduction, Tables, Queries, Forms, Reports, Opening & Saving database files, Creating Tables, Table Design, Indexing, Entering data, importing data.

**Unit IV** **7 Hours**

**Creating Queries:** SQL statements, setting relationship, using wizards. **Creating Forms:** GUI, Form, Creating & printing reports.

**Text books:**

1. Silberschatz, A. and Korth, H. F. and Sudarshan, S. 2011. Database System Concepts, 6<sup>th</sup> Ed. McGraw Hill.
2. Pratt P. and Last M. 2013. Microsoft Access 2013: Comprehensive. Cengage Learning.

**Suggested readings**

1. Elmarsi, R. and Navathe, S. B. 2013. Fundamentals of Database Systems, 5<sup>th</sup> Ed. India: Pearson Education.
2. Davis, G. H. 2010. Beginning Microsoft Office 2010. Apress.

## SEMESTER- III

CST.601

Advanced Computer Graphics

Credit Hours: 4

**Objective:** This course is designed to provide a comprehensive introduction to computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends. It is utilized for design, presentation, education and training. Computer Graphics and its derivative, visualization, have become the primary tools by which the flood of information from Computational Science is analyzed.

### Unit I 14 Hours

**Introduction to Computer Graphics:** Overview of Computer Graphics, Computer Graphics Applications, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Color CRT Monitors, Video Basics, The Video Controller, Random-Scan Display Processor.

**Output Primitives:** Points and Lines, Line Drawing Algorithms, Circle-generating algorithms, other curves and filled area primitives, Attributes of output primitives.

### Unit II 14 Hours

**Two-Dimensional Transformations:** Basic Transformations: Translation, Rotation, Scaling, Transformation Conventions, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Combined Transformation, Transformation between Coordinate Systems, Affine Transformation.

**Two Dimensional Viewing:** The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformations, Two-Dimensional viewing functions, Point clipping, line clipping, polygon clipping

### Unit III 14 Hours

**Three-Dimensional Transformations:** Introduction, Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation, Composition of 3D Transformations.

**Viewing in 3D:** Viewing Pipeline, Viewing Coordinates, Projections, General project transformations, Clipping. Projection: Classification of 3D to 2D Projections.

### Unit IV 14 Hours

**Visible-Surface Determination Methods:** Classification of Visible- Surface Detection Algorithms, Back-Face Detection, Depth-Buffer Method, A-Buffer Method, Scan-Line Method, Depth-Sorting Method, BSP-Tree Method, Area-Subdivision Method, Curved Surfaces.

**Computer Animation:** Design of Animation Sequences, General Computer-Animation Functions, Raster Animations, Computer-Animation Languages, Key-Frame Systems, Motion Specifications.

**Advanced object modelling:** Natural phenomena and Characters.

#### Text books:

1. BAKER, M.P. 2008. Computer Graphics. 7<sup>th</sup> ed. Prentice-Hall
2. McConnell, J.J. 2006. Computer Graphics: Theory Into Practice. Jones & Bartlett Learning.
3. Bhatia, P.K. 2008. Computer Graphics. I. K. International Pvt Ltd.

4. Mukherjee, D.P. and Jana, D. 2010. Computer Graphics: Algorithms and Implementations. PHI Learning Pvt. Ltd.
5. Xiang, Z., Plastock, R. A. 2000. Schaum's Outline of Computer Graphics. 2<sup>nd</sup> ed. McGraw-Hill Professionals.

**Suggested readings:**

1. Pharr, M. and Humphreys, G. 2004. Physically based rendering. Morgan Kaufmann.
2. Desai, A.A. Computer Graphics PHI Learning Pvt. Ltd.

**Elective-I**

**CST.602**

**Digital System Design**

**Credit Hours: 4**

**Objective:** At the end of this course, the student will be able to analyze, design, and evaluate digital circuits, of medium complexity, that are based on SSIs, MSIs, and programmable logic devices.

**Unit I**

**14 Hours**

**Minimization and Design of Combinational Circuits:** minimization with theorems, Karnaugh Map, Variable-entered mapping and Tabulation method. Design of Arithmetic circuits, multiplexer, decoder, CPLD and FPGA level customized design.

**Unit II**

**14 Hours**

**Sequential Machine Fundamentals:** Need for sequential circuits, Distinction between combinational and sequential circuits, Concept of memory, Binary Cell, Classification of sequential machines, Flip-Flop, Design of clocked Flop-Flops, Conversion of Flip- Flops.

**Traditional Approach to Sequential Analysis and Design:** State Diagram, Analysis, Design of Synchronous sequential circuits, State Reduction, Minimizing the next state decoder, Output decoder design, Counters, Design of Single Mode, Multi-Mode Counters, Ring Counters. Shift Registers.

**Unit III**

**16 Hours**

**Multi-Input System Controller Design:** System Controllers, timing and frequency considerations, MDS Diagram Generation, Synchronizing to systems and choosing controller Architecture, State Assignment, Next State Decoder, Next State decoder maps, Output Decoder, Control and display.

**System Controller Utilizing Combination MSI/LSI Circuits:** Using the MSI decoders in system controller, MSI multiplexes in system controller, Indirect- Addressed Multiplexer Configuration.

**Unit IV****12 Hours**

**Asynchronous Finite-State Machines:** Introduction, Asynchronous Analysis, The Design of Synchronous Machines, Cycles and races, Hazards, Read only memories, ROM'S PROMS and applications, Using the ROM random logic, Programmed Logic arrays, Applications of PLA

**Text books:**

1. Mano, M. and Charles, K. 2007. Logic and Computer Design Fundamentals 4<sup>th</sup> ed. Pearson Education.
2. Fletcher W. I. 2007. An Engineering Approach to Digital Design. Prentice Hall India Pvt. Ltd.

**CST.603****Secure Coding****Credit Hours: 4**

**Objective:** This course aims to provide an understanding of the various security attacks and coding errors that lead to vulnerabilities.

**Unit I****14 Hours**

**Introduction:** Security, CIA Triad, Viruses, Trojans, and Worms In a Nutshell, Security Concepts- exploit, threat, vulnerability, risk, attack. Malware Terminology: Rootkits, Trapdoors, Botnets, Key loggers. Types of Security Vulnerabilities- buffer overflows, Invalidated input, race conditions, access-control problems, weaknesses in authentication, authorization, or cryptographic practices.

**Unit II****14 Hours**

**Need for Secure Systems:** Proactive Security development process, Secure Software Development Cycle (S-SDLC) , Security issues while writing SRS, Design phase security, Development Phase, Test Phase, Maintenance Phase, Writing Secure Code – Best Practices SD3 (Secure by design, default and deployment).

**Threat Modelling Process and its Benefits:** Identifying the Threats by Using Attack Trees and rating threats using DREAD, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization. Defence in Depth and Principle of Least Privilege.

**Unit III****14 Hours**

**Secure Coding Techniques:** Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices In Java Technology. ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues. Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM

**Unit IV****14 Hours**

**Testing Secure Applications:** Security code overview, Secure software installation, Role of the Security Tester, Building the Security Test Plan. Testing HTTP-Based Applications, Testing File-Based Applications, Testing Registry-Based Applications, Testing Clients with Rogue Servers.



**Text Books:**

1. LeBlanc, D. and Howard, M. 2002. Writing Secure Code. 2<sup>nd</sup> Edition. Pearson Education.
2. Deckard, J. 2005. Buffer Overflow Attacks: Detect, Exploit, Prevent. 1<sup>st</sup> Edition. Syngress.
3. Shostack, A. 2014. Threat Modeling: Designing for Security. John Wiley & Sons.

**CST.604****Theory of Computation****Credit Hours: 4**

**Objective:** To introduce the theory of computation through a set of abstract machines that serve as models for computation - finite automata, pushdown automata, and Turing machines – and examines the relationship between these automata and formal languages.

**Unit I****14 Hours**

**Introduction:** Introduction to Finite Automata, Description of Finite Automata, Deterministic Finite Automata, Notations for DFA, DFA Design Techniques, Applications of Finite Automata, Non-deterministic Finite Automata, Equivalence of Deterministic and Non-Deterministic Finite Automata.

**Unit II****14 Hours**

**Finite Automata and Regular Expressions:** e-NDFA, Conversion from e-NDFA to DFA, Regular Expressions, Construction of Regular Expression from DFA, Algebraic Laws for Regular Expressions, Properties of Regular Languages: Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages.

**Unit III****14 Hours**

**Context Free Languages:** Context Free Grammars, Chomsky Hierarchy, Grammar from Finite Automata, Grammar from Regular Languages, Derivation: Leftmost Derivation, Rightmost Derivation, Derivation Tree, Ambiguous Grammar, Applications of Context Free Grammars, Normal Forms for Context Free Grammar, Properties of Context Free Languages.

**Unit IV****14 Hours**

**Pushdown Automata:** Transitions, Graphical Notations, Instantaneous Description, Acceptance of Language by PDA, Construction of PDA.

**Turing Machines:** Definition of Turing Machine, Computing with Turing Machines, Extensions to Basic Turing Machine.

**Decidability:** Decidable Languages, undecidable languages, Halting problem of Turing machine.

**Text books:**

1. Mishra, K.L.P. and Chandrasekaran, N. 2008. Theory of Computer Science: Automata, Languages and Computation. 3rd ed. PHI Learning Pvt. Ltd.
2. Hopcroft, J.E., Motwani, R. and Ullman, J.D. 2008. Introduction to Automata Theory, Languages, and Computation. 3<sup>rd</sup>ed. Addison Wesley.

3. Padma Reddy, A.M. 2001. Finite Automata and Formal Languages: A Simple Approach. India: Pearson Education.
4. Linz, P. 2011. An Introduction to Formal Languages and Automata. 5th ed. Jones & Bartlett Publishers.
5. Pandey, Adesh K, An Introduction to Automata Theory and Formal Languages 5<sup>th</sup> Edition S K Kataria Publishers.
6. Cohen, D. I. A. 2003. Introduction to Computer Theory. 2<sup>nd</sup> ed. John Wiley.

**CST.605**

**Advanced Computer Graphics**

**Credit Hours: 2**

In this practical session students should be asked to

- WAP for 2D line drawing.
- WAP to draw Circle using Mid-Point Algorithm.
- WAP for Polygon filling.
- WAP for Line Clipping.
- WAP for Polygon Clipping.
- WAP showing rotation of a Line.
- WAP showing scaling and translation of a Circle.
- WAP showing scaling, translation, and rotation of a Triangle.
- WAP for displaying 3D objects as 2D display using perspective transformation.
- WAP for rotation of a 3D objects about arbitrary axis.
- WAP for Hidden surface removal from a 3D objects.
- WAP to make a hut, kite and a fish.
- WAP to animate a fish.
- Any program related to the subject.

**CST.606**

**Seminar- II**

**Credit Hours: 2**

The students should be asked to give seminar on advanced topic/case study/technology/tool in the field of Computer Science. The purpose of the seminar is to judge the knowledge of the students in field of Computer Science and to discuss current trends in the field.

**CBS.607**

**Dissertation Part-I**

**Credits: 12**

The objective of dissertation part-1 would be to ensure that the student learns the nuances of the scientific research. Herein the student shall have to carry out the activities/experiments to be completed during Dissertation Part-I (as mentioned in the synopsis).

The students would present their work to the evaluation Committee (constituted as per the university rules). The Evaluation criteria shall be as detailed below:

| Evaluation Parameter                      | Maximum Marks | Evaluated By         |
|---|---------------|----------------------|
| Mid Term Report                           | 100           | Evaluation Committee |
| Presentation and defence of research work | 100           |                      |
| Continuous evaluation of student          | 100           | Supervisor           |
| <b>Total</b>                              | <b>300</b>    |                      |

#### SEMESTER- IV

**CST.608**

**Parallel and Distributed Computing**

**Credit Hours: 4**

**Objective:** To acquaint the students with the advanced concepts of Parallel and Distributed Computing.

#### Unit I

**14 Hours**

**Introduction:** Parallel Architecture, Convergence of Parallel Architecture, Fundamental Design Issues, Flynn's Taxonomy, Pipelining, MIMD, SIMD, Parallelization Process, Data Access and Communication in Multimemory System.

**Connectivity:** Synchronising Communications, Network Designs, Reconfigurable Systems, System Interconnections.

**Processor Arrays, Multiprocessors and Multi-Computers:** Processor Organizations, Processor Arrays, Multi-Processors and Multi-Computers.

#### Unit II

**14 Hours**

**PRAM:** Model of Serial Computation, PRAM Model of Parallel Computation, PRAM Algorithms: Parallel Reduction, Prefix Sums, Preorder Tree Traversal, Merging two Unsorted Lists, Graph Colouring.

**Shared Memory Multiprocessors:** Cache Coherence, Memory Consistency, Synchronization.

**Scalable Multiprocessors:** Scalability, Realizing Programming Models, Dedicated Message Processing, Implications for Parallel Softwares, Synchronization.

#### Unit III

**14 Hours**

**Introduction:** Examples of Distributed Systems, Trends in Distributed Systems, Resource Sharing, System Models: Physical Models, Architectural Models, Fundamental Models.

**Networking and Internetworking:** Types of Network, Network Principles, Internet Protocols.

**Communication in Distributed Systems:** Interprocess Communication, Remote Invocation, Indirect Communication.

**Deadlock Detection in Distributed Systems:** Systems Model, Models of Deadlock, Knapp's Classification of Distributed Deadlock Detection Algorithms.

#### Unit IV

**14 Hours**

**Operating System Support:** Operating System Layer, Protection, Processes and threads, Operating System Architecture.

**Distributed File Systems:** File Service Architecture, Case Study: Sun Network File System, Andrew File System.

**Distributed Multimedia Systems:** Characteristics of multimedia data, Quality of service management, Resource management, Stream Adaptation.

**Designing Distributed Systems:** Case Study of Google.

**Text books**

1. Culler, E.D. Singh, J.P. Gupta, A. 2011. Parallel Computer Architecture Hardware/ Software Approach Gulf Professional Publishing.
2. Fountain, T.J. 2006. Parallel Computing: Principles and Practice Cambridge University Press.
3. Quinn, M.J. 2002. Parallel Computing: Theory and Practice Tata McGraw Hill Education.
4. Coulouris, G. Dollimore, J. Kindberg, T. Blair, G. 2011 Distributed Systems: Concepts and Design, 5th Edition Addison Wesley Publishing Company.
5. Kshemkalyani, A.D. Singhal, M. 2008. Distributed Computing: Principles, Algorithms, and Systems Cambridge University Press.
6. Liu, M.L. 2004. Distributed Computing : Principles and Applications Pearson Education India
7. Garg, V.K. 2002. Elements of Distributed Computing John Wiley & Sons.

**Elective-II**

**CST.609**

**Biometric Security**

**Credit Hours: 4**

**Objective:** The main objective is to enhance the security infrastructure in the industry and generally in information sensitive environments, through the use of new types of biometrics that describe the person's internal rather than external physiology.

**Unit I 14 Hours**

**Biometrics Introduction:** Benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, comparison of various biometric traits, Applications. Key biometric terms and processes: biometric verification and identification, how biometric matching works. Accuracy in biometric systems, Metrics for evaluating biometric systems: FAR, FRR, ERR etc.

**Unit II 14 Hours**

**Physiological Biometric Technologies:** Fingerprints: Working, characteristics, Competing technologies, strengths, weaknesses and deployment.

**Facial scan:** Working, Strengths, weaknesses and deployment. Advanced Topics: Handling pose, illumination, and expression variations, Heterogeneous face recognition, Face modeling. **Iris Scan:** working, strengths, weaknesses and deployment. **Voice Scan:** working, characteristics, strengths, weaknesses and deployment. **Retina Scan:** working, characteristics, strengths,

weaknesses and deployment. **Hand Scan:** working, characteristics, strengths, weaknesses and deployment.

### Unit III

14 Hours

**Behavioral Biometric Technologies:** Handprint Biometrics, Signature technology: Technical description, classification, keystroke-scan.

**Multi Biometrics:** Multi-modal biometric Systems, Multi-sensor systems, Multi-algorithm systems, Multimodal fusion techniques.

**Repositories for Database and Template Storage:** Features and Capabilities of a DBMS, Biometric data and databases, database issues, Biometric databases.

### Unit IV

14 Hours

**Security of Biometric Systems:** Adversary Attacks, attacks at the user interface, attack on biometric processing, Attacks on the template database, Database security, Template security techniques.

**Advanced Topics in Biometrics:** Biometrics in Internet-Ecommerce, Integrated Biometrics, VLSI Biometrics.

#### Text books:

1. Jain, A. K., Ross, A. A., and Nandakumar, K. 2011. Introduction to Biometrics. Springer Science & Business Media.
2. Zhang, D. 2000. Automated Biometrics: Technologies and Systems. Springer Science & Business Media.
3. Nanavati, S., Thieme, M. and Nanavati, R. 2002. Biometrics: Identity Verification in a Networked World. John Wiley & Sons.
4. Newman, R. 2009. Security and Access Control Using Biometric Technologies. Cengage Learning.
5. Bolle, R. 2004. Guide to Biometrics. Springer Science & Business Media.

#### Suggested readings:

1. Ross, A. A., Nandakumar, K. and Jain, A.K. 2006. Handbook of Multibiometrics. Springer Science & Business Media.
2. Chirillo, J. and Blaul, S. 2003. Implementing Biometric Security. Wiley.
3. Wang, P. S. P. 2012. Pattern Recognition, Machine Intelligence and Biometrics. Springer Science & Business Media.
4. Articles in various journals and conference proceedings.

**Objective:** To introduce the concept of Neural Networks, Fuzzy Systems, Genetic Algorithms and Hybrid Systems to the students.

**Unit I****14 Hours**

**Neural Networks:** Introduction to Neuron, Modeling Neuron, Feedforward Neural Network, Learning Methods, Data Normalization, Supervised Training Methods, Unsupervised Training Methods, Hopfield Neural Networks, Bidirectional Associative Memory.

**Unit II****14 Hours**

**Fuzzy Systems:** Fuzzy Set Theory: Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations, Fuzzy Systems: Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Applications.

**Unit III****14 Hours**

**Genetic Algorithms:** History, Basic Concepts, Working Principle, Encoding, Fitness Function, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bitwise Operators, Generational Cycles, Convergence of Genetic Algorithm, Applications.

**Unit IV****14 Hours**

**Hybrid Systems:** Introduction, Neural Networks, Fuzzy Logic, Genetic Algorithm Hybrids, Genetic Algorithm Based Propagation Networks, Fuzzy Propagation Networks, Fuzzy Associative Memories, Soft Computing Tools.

**Text books**

1. Rajasekaran, S. VijayalakshmiPai, G.A. 2003. Neural Networks, Fuzzy Logic and Genetic Algorithms PHI Learning.
2. Priddy L.K., Keller E.P., 2005. Artificial Neural Networks: An Introduction SPIE Press.
3. Ross J.T., 2009 Fuzzy Logic with Engineering Applications John Wiley & Sons.
4. Gen, M. Cheng, R. 2000. Genetic Algorithms and Engineering Optimization John Wiley & Sons.
5. Sivanandam, S. N., Deepa, S. N. 2007. Principles of Soft Computing. John Wiley & Sons.

In Dissertation Part -2 the student shall have to carry out the activities/experiments to be completed during Dissertation Part-II (as mentioned in the synopsis). The students would present their work to the evaluation Committee (constituted as per the university rules). The Evaluation criteria shall be as detailed below:

| <b>Evaluation Parameter</b>               | <b>Maximum Marks</b> | <b>Evaluated By</b>  |
|---|----------------------|----------------------|
| Final Report                              | 150                  | Evaluation Committee |
| Presentation and defence of research work | 150                  |                      |
| Continuous evaluation of student          | 100                  | Supervisor           |
| <b>Total</b>                              | <b>400</b>           |                      |