Course Name	**ADVANCED ALGORITHM DESIGN AND ANALYSIS**
Course Code	**CSN501**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**UG level course in Algorithm design and analysis**

Total Number of Lectures:42

COURSE OBJECTIVE
• To introduce students to the methods of designing and analyzing algorithms.
• Gain the ability to analyze best case, average case and worst-case running time of algorithms and advanced algorithmic problems.
• Familiarize with basic paradigms and data structures used to solve algorithmic problems.
• Understanding of different classes of problems with reference to their computation difficulties
• To introduce the students with recent developments in the area of algorithmic design.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
OVERVIEW Algorithm concepts, asymptotic efficiency of algorithms, asymptotic notations and their properties, Recurrence equations and method of solving recurrences, Searching using hash tables, open addressing using linear probing, Medians and order statistics.	**(03)**
DYNAMIC PROGRAMMING Deterministic & probabilistic, greedy algorithms, amortized analysis.	**(05)**
ADVANCED DATA STRUCTURES B trees, B+ trees, data structures for disjoint sets.	**(05)**
ADVANCED GRAPH ALGORITHMS Breadth First and Depth First Search, minimum spanning trees, shortest path algorithms: single source and all pair, max flow problem and its solutions.	**(06)**
LINEAR PROGRAMMING Standard and Slack forms, Formulating problems as linear programs, simplex algorithm, representation of polynomials, DFT and FFT.	**(06)**
STRING MATCHING Rabin Karp algorithm, String matching with finite automaton, Knuth-Morris-Pratt algorithm.	**(06)**
NP-COMPLETENESS CONCEPTS Polynomial time verification, NP-completeness and reducibility, showing problems to be NP-complete like Clique problem, vertex cover problem etc.	**(06)**
APPROXIMATE ALGORITHMS Approximate algorithms for vertex cover problem, traveling sales person problem, sum-subset problem.	**(05)**

COURSE OUTCOME
After completion of course, students would be able to:
• Use different computational models (e.g., divide-and-conquer), to analyze the complexity/performance of different algorithms.
• Understand the difference between the lower and upper bounds of various problems and their importance in deciding the optimality of an algorithm.

• Use various techniques for efficient algorithm design (divide-and-conquer, greedy, and dynamic algorithms) and be able to apply them while designing algorithms.
• Augment various data structures(trees and arrays) to support specific application
• To understand various advanced design and analysis techniques such as greedy algorithms, dynamic programming
• Know the concepts of tractable and intractable problems and the classes P, N an NP-complete problems

REFERENCE(s):
1. Cormen, Leiserson, Rivest, Stein, “Introduction to Algorithms”, Prentice Hall of India.
2. Horowitz, Sahini, “Fundamentals of algorithms”, University Press.
3. Brassard, Bratley, “Fundamentals of algorithms”, Prentice Hall of India.
4. Knuth, “The Art of Computer Programming”, Vol. I-III, Pearson Education.
5. Kleinberg and Tardos, “Algorithm Design”, Pearson Addison-Wesley

Course Name	**ADVANCED COMPUTER NETWORKS**
Course Code	**CSN502**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**UG level course in Computer Networks**

Total Number of Lectures:42

COURSE OBJECTIVE
• To develop and understanding of network architectures from the design and performance perspective
• To introduce the students to the major concepts of MAC protocols for various network technologies.
• To expose the students to various internetworking, routing and multicasting issues and protocols.
• Understand the working principles and design issues of transport layer protocols.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
INTRODUCTION Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols.	**(02)**
MEDIUM ACCESS MAC protocols for high-speed LANS, MANs, and wireless LANs. (For example, FDDI, DQDB, HIPPI, Gigabit Ethernet, Wireless Ethernet, etc.), CSMA/CD, CSMA/CA, Simple performance models; WAN access methods - PPP.	**(06)**
INTERNETWORKING AND ROUTING Packet Switching, The Internetworking Problem, Internet Routing Architecture: Internet Service Providers and Peering Border Gateway Protocol (BGP), Border Gateway Protocol (continued), BGP instability, Fair queuing, Wireless TCP, The IP/TCP split connections, Scaling IP, Routers: Forwarding and Routing, The IP forwarding path, Unicast Internet routing: Intra and Inter domain routing, Internet Routing-in-the-wild, Router Design and Implementation, Security problems with Internet Architecture, IPV6, Mobile IP.	**(08)**
RESOURCE MANAGEMENT End-to-End Congestion Control, Router-Assisted Congestion Control: Active Queue Management, Fair Queuing and Variants, Modeling and Measurement: Packet Trains, TCP Congestion Control Impediments, Adaptive Network Applications, QoS: Why QoS; Basic Models and Architecture, Mechanisms and Properties, Modeling and Measurement: Traffic Self-Similarity.	**(08)**
GROUP COMMUNICATION Multicast Routing and Transport, IP Multicasting: Multicast routing protocols, address assignments, session discovery, Multicasting in mobile networks.	**(05)**
TRANSPORT LAYER PROTOCOL TCP protocol dynamics, TCP extensions for high-speed networks, transaction-oriented applications. Other new options in TCP, Application protocols for email, ftp, web, DNS.	**(05)**
WIRELESS NETWORKS Wireless LAN architecture, Mobile IP, Broadcast file system, Agent technology, Satellite technology.	**(04)**
SECURITY Network security at various layers. Secure-HTTP, SSL, Transport Layer security, ESP, Authentication header, Key distribution protocols. Digital signatures, digital certificates.	**(04)**

COURSE OUTCOME	
After completion of course, students would be able to: • Grasp the concepts and characteristics of various network architectures • Understand various types of multiple access protocols for various network technologies. • Identify and understand the various design issues of internetworking, routing and multicasting. • Understand the working principles and design issues of transport layer protocols.	

REFERENCE(s):	
1. Computer Networking, A Top-Down Approach Featuring the Internet - J. Kurose and K. Ross, 3rd Ed. (Pearson). 2. Computer Networks, A Systems Approach - L. Peterson and B. Davie, 3rd Ed. (Elsevier) 3. Andrew Tanenbaum. Computer Networks, PHI 4. W. R. Stevens. TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996. 5. W. Stallings, Cryptography and Network Security: Principles and Practice, 2nd ed, Prentice Hall, 1998. 6. E. Perkins, B. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, Addison Wesley, 1997. 7. Articles in various journals and conference proceedings.	

Course Name	**MATHEMATICAL CONCEPTS IN COMPUTER SCIENCE**
Course Code	**CSN503**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Basic Mathematical concepts**

Total Number of Lectures:42

COURSE OBJECTIVE

- To understand the mathematical fundamentals that is prerequisites for variety of courses like Automata, Data Structure, Cryptography, DBMS etc.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design and concurrency

LECTURE WITH BREAKUP	NO. OF LECTURES
MATHEMATICAL AND STATISTICAL MODELS Useful Statistical Models, Discrete Distributions, Continuous Distributions, Poisson Process, Properties of a Poisson Process, Non-stationary Poisson Process, Empirical Distributions.	**(05)**
QUEUING MODELS Characteristics of Queuing Systems, The Calling Population, System Capacity, The Arrival Process, Queue Behavior and Queue Discipline, Service Times and the Service Mechanism Queuing Notation, Long-Run Measures of Performance of Queuing Systems, Costs in Queuing Problems, Markovian Models, Single-Server Queues with Poisson Arrivals, Multi-server Queues with Poisson Arrivals.	**(06)**
RANDOM-NUMBERS Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Linear Congruential Method, Combined Linear Congruential Generators, Random-Number Streams, Tests for Random Numbers, Frequency Tests, Tests for Autocorrelation	**(07)**
OUTPUT ANALYSIS FOR A SINGLE MODEL Stochastic Nature of Output Data, Measures of Performance and Their Estimation, Point Estimation, Confidence-Interval Estimation, Output Analysis for Terminating Simulations, Confidence Intervals with Specified Precision, Quantiles, Estimating Probabilities and Quantiles from Summary Data, Error Estimation for Steady-State Simulation, Replication Method for Steady-State Simulations, Sample Size in Steady-State Simulations.	**(06)**
COMPARISON AND EVALUATION OF ALTERNATIVE SYSTEM DESIGNS Comparison of Two System Designs, Independent Sampling with Equal Variances, Independent Sampling with Unequal Variances, Common Random Numbers (CRN), Confidence Intervals with Specified Precision, Comparison of Several System Designs, Bonferroni Approach to Multiple Comparisons, Metamodeling, Simple Linear Regression, Testing for Significance of Regression, Multiple Linear Regression, Random-Number Assignment for Regression, Optimization via Simulation.	**(06)**
LINEAR ALGEBRA Fields, Vector Spaces, Basis, Matrices and Linear Transformations, Eigen values, Orthogonality, Vector and Matrix Norms - Applications to optimization problems and graph theory.	**(04)**
PROBABILITY Sample space, Distributions, Random Variables, Expectation, Tail Inequalities – Chernoff Bound, Chebyshev inequality, Functions of random variables, Applications. **COMBINATORICS** General Counting methods, Recurrence relations, Generating Functions, Principle of Inclusion-Exclusion, Posets and Lattices - Permutations, Groups and algebraic structures.	**(04)** **(04)**

COURSE OUTCOME	
After completion of course, students would be able to: • Formulate logic expressions for a variety of applications. • Convert a logic expression into a Boolean circuit, and vice versa. • Use trees and graphs to formulate computational problems.	

REFERENCE(s):
1. Trembly, J.P.,& Manohar R Discrete Mathematical Structures
2. Rosen K H Discrete Mathematics and its Application
3. Biggs N L Discrete Mathematics, Oxford University Press
4. Deo N. Graph Theory with Applications to Engineering and Computer Science
5. Lipschutz S and Lipson M Discrete Mathematics
6. Koloman, Busby & Ross, Discrete Mathematical Structures, PHI.
7. Olofsson P. , "Probability, Statistics and Stochastic Processes", Wiley Interscience
TEXTBOOK(s):
1. Discrete Event System Simulation by Jerry Banks , Pearson Education
2. Probability and Random Processes with Applications to Signal Processing , Henry Stark/John W. Woods, Pearson Education

Course Name	**SPECIAL TOPICS IN WIRELESS AND MOBILE NETORKS**
Course Code	**CSN505**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Computer Networks**

Total Number of Lectures:42

COURSE OBJECTIVE
• To introduce the basic concepts of wireless transmission
• To get a basic introduction to key concepts and techniques underlying cellular communication and medium access control in wireless networks
• To learn the architecture and issues related to IEEE 802.11 wireless LAN
• To understand the functioning of different types of wireless networks including mobile adhoc and sensor networks

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction to wireless networking Advantages and disadvantages of wireless networking, Evolution of Mobile Communication generations, Multiple Access Technologies- CDMA, FDMA, TDMA, Frequency reuse, Radio Propagation and Modeling, Challenges in mobile computing: Resource poorness, Bandwidth, energy, etc.	**(04)**
Cellular Concepts Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies, Protocols for digital cellular systems such as GSM, EDGE, GPRS, UTMS	**(10)**
IEEE 802.11 WLAN Wireless LANs Physical & MAC layer, IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node Problems, Fading Effects in Indoor and outdoor	

WLANs, WLAN Deployment issues**,** TCP over wireless networks, Approaches to improve transport layer performance.	**(10)**
Ad hoc Networks Introduction, Routing protocols - Destination sequenced distance vector algorithm, Cluster based gateway switch routing, , Ad hoc on-demand routing, Location aided routing, Zonal routing algorithm.	**(03)**
Wireless Sensor Networks Introduction, Application, Physical, MAC layer and Network Layer,Power Management, Tiny OS	**(04)**
Wireless PANs Bluetooth AND Zigbee, Introduction to Wireless Sensors, Introduction to Vehicular Adhoc Networks	**(03)**
Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, IEEE 802.11x and IEEE 802.11i standards, DoS in wireless communication	**(08)**

COURSE OUTCOME
After completion of course, students would be able to:
• Grasp the concepts and characteristics of wireless signals and transmission channels
• Understand various types of multiple radio access techniques, cellular and underlying propagation and performance analysis concepts
• Identify the various design issues of WLAN, its architecture and related issues
• Understand the working principles and design issues of various wireless networks

TEXTBOOK(s):
1. Schiller J., Mobile Communications, Addison Wesley (2000).

REFERENCE(s):
1. Stallings W., Wireless Communications and Networks, Pearson Education (2005).
2. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc (2002).
3. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc, (2000).
4. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI (2004)

Course Name	**ADVANCED TOPICS IN DATABASE SYSTEMS**
Course Code	**CSN506**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Knowledge of relational database management systems**

Total Number of Lectures:42

COURSE OBJECTIVE

1. To learn Database Management Systems (DBMSs) features such as indexing structures, concurrency control, recovery control, transactional models, and query optimization.
2. To learn advanced topics of databases like object-oriented, parallel and distributed databases
3. To implement the concepts of decision-support models in various database applications
4. To learn state-of-art techniques in database systems for research as well as practical work.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
REVIEW OF RELATIONAL DATA MODEL AND RELATIONAL DATABASE CONSTRAINTS Relational model concepts; Relational model constraints and relational database schemas; Update operations, transactions and dealing with constraint violations.	**(04)**
OBJECT AND OBJECT-RELATIONAL DATABASES Overview of Object-Oriented Concepts, complex objects; Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems, The nested relational model.	**(10)**
ENHANCED DATA MODELS FOR ADVANCED APPLICATIONS Active database concepts and triggers; Temporal, Spatial, and Deductive Databases, Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management, XML Databases, Real-time Databases	**10**
PARALLEL AND DISTRIBUTED DATABASES Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases – architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.	**10**
DECISION SUPPORT SYSTEMS Introduction to decision support, Decision Making systems- modeling and Analysis, Decision support system development.	**08**

OUTCOME

After completion of course, students would be able to:

1. Analyze the advanced concepts along with their application areas
2. Implement applications based on decision support systems
3. Implement advanced concepts of databases to resolve various research issues
4. Design efficient algorithms to solve various database problems
5. Design recovery protocols for distributed databases and parallel database architectures

REFERENCE(s):

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGrawHill,2010.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition,McGraw-Hill,2003
3. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education, 2007.
4. Connolly and Begg: Database Systems, 4th Edition, Pearson Publications, 2005.

Course Name	**SOFTWARE QUALITY MANAGEMENT**
Course Code	**CSN507**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**-**

Total Number of Lectures:42

COURSE OBJECTIVE
• To provide the students with theoretical knowledge about concepts of software quality, about the quality - models, - standards and – methodologies used in software industry.
• Understanding and usage of the theory is consolidated by the case studies and exercises.
To understand software quality in its complexity, to see the differences and interconnections among the most popular software quality models, standards and approaches

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Concepts and Overview: Concepts of software quality, quality attributes, software quality control and software quality assurance, evolution of SQA, major SQA activities, major SQA issues, zero defect software, Software Quality Assurance: The philosophy of assurance, the meaning of quality, the relationship of assurance to the software life cycle, SQA techniques. Tailoring the Software Quality Assurance Program: Management review process, technical review process, walkthrough, software inspection process, configuration audits, document verification.	**(10)**
Evaluation: Software requirements, preliminary design, detailed design, coding and unit test, integration and testing, system testing, types of evaluations. **Error Reporting**: Identification of defect, analysis of defect, correction of defect, implementation of correction, regression testing; Categorization of defect, relationship of development phases.	**10**
Trend Analysis: Error quantity, error frequency, program unit complexity, compilation frequency. Corrective action as to Cause: Identifying the requirement for corrective action, determining the action to be taken, implementing the corrective action, documenting the corrective action, periodic review of actions taken.	**10**
CASE tools and their effect on Software Quality: Software Quality Metrics, Standards, certification and assessment, Quality management standards, Quality standards with emphasis on ISO approach, Capability Maturity Models-CMM and CMMI, TQM Models, Bootstrap methodology, The SPICE project, ISO/IEC 15504, Six Sigma Concept for Software Quality.	**12**

COURSE OUTCOME
After completion of course, students would be able to:
• To develop ability to analyze the relations among software product, process and project in quality assurance and management.
• To describe and apply professional practices in managing the development of quality software.
• Explain and plan quality assurance activities in software projects.
• To understand the relationships between software process improvement and software quality management

TEXTBOOK(s):
1. Mordechai Ben-Manachem, Garry S. Marliss, Software Quality: Producing Practical, Consistent Software, International Thomson Computer Press.
REFERENCE(s):
1. Daniel Galin, Software Quality Assurance from Theory to Implementation, Pearson Education.
2. Robert Dunn, Software Quality: Concepts and Plans, Prentice Hall.
3. Watts Humphery, A discipline for Software Engineering, Addison Wesley, Massachusetts.

4. Kamna Malik, Praveen Choudhary, Software Quality - A Practitioner's Approach, Tata McGraw Hill.

Course Name	**LOGIC AND FUNCTIONAL PROGRAMMING**
Course Code	**CSN508**
Credits	**04**
LTP	**3 0 0**
Pre-Requisites	

Total Number of Lectures:42

COURSE OBJECTIVE
• To further the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming, functional programming and constraint logic programming.
• Introduction into formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience.

LECTURES WITH BREAKUPS	**NO. OF LECTURES**
Proposition Logic Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table , Problem Solving with Semantic Table.	**04**
Natural Deduction and Axiomatic Propositional Logic Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments	**06**
Introduction to Predicate Logic Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming	**08**
Semantic Tableaux & Resolution in Predicate Logic Semantic Tableaux, Instantiation Rules, Problem-solving in Predicate Logic, Normal forms, Herbrand Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool	**08**
Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter.	**08**
Lazy and Eager Evaluation strategies Evaluation Strategies, Lazy Evaluation: Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning	**08**

COURSE OUTCOME
After completion of course, students would be able to:
• Understanding of the theory and practice of functional and logic programming.
• The ability to write functional and logic programs.
• The ability to solve problems in and using functional and logic programming.

TEXTBOOK(s):
1. John Kelly, "The Essence of Logic", Prentice-Hall India.
2. Saroj Kaushik, "Logic and Prolog Programming", New Age International ltd

REFERENCE(s):
1. Tasami Hagiya and Philip waddle, "Functional and Logic Programming" ,8/E, 2006
2. Testsuo Ida,Atsushi ohori and Masato Takichi, "Functional and Logic Programming", 2006
3. Chang, C.L and Lee R.C .T, "Symbolic Logic and Mechanical theorem proving", Academic Press, New York, 2006
4. J.W. Lloyed, Springer Verlog, "Foundation of logic programming", New York, 2/E, 1987

Course Name	**ADVANCED COMPUTER ARCHITECTURE**
Course Code	**CSN509**
Credits	**03**

LTP	**3 0 0**
Pre-Requisites	**UG level course in Computer Architecture**

Total Number of Lectures:42

COURSE OBJECTIVE
• To provide students with a broad understanding of computer architecture
• To study architectures exploiting instruction-level parallelism (ILP), and multiprocessors and minicomputers.
• To provide exposure to current and emerging trends in Computer Architectures

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction to Parallel Processing: Parallelism in uniprocessor system; parallel computer structure, architectural classification schemes.	**(05)**
Memory management and organization: Memory hierarchy, Virtual memory system, memory allocation and management, cache memory management. mapping and management techniques, memory replacement policies.	**(10)**
Pipelining and Vector Architecture: Instruction and arithmetic pipelines design, linear and non-linear pipeline pipeline processors, superscalar and superpipeline design.	**(08)**
SIMD array architecture: SIMD array processors, SIMD interconnection network, Associative array processors.	**(07)**
MIMD multiprocessor and multicomputers: Multiprocessor architecture (loosely coupled, tightly coupled), interconnection networks, cache coherence and synchronization mechanism multiprocessor operating systems, exploiting concurrency.	**(08)**
Review of modern processors Pentium Processor: IA 32 and P6 micro architectures, ARM Processor.	**(04)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Understand the advanced concepts of computer architecture.
2. Investigate modern design structures of Pipelined and Multiprocessors systems.
3. Understand the interaction amongst architecture, applications and technology

TEXTBOOK(s):
1. **Advanced Computer Architectures - A Design space approach**, Dezso Sima, Terence Fountain, Peter Kacsuk, Pearson Education 1997.
REFERENCE(s):
1. K Hwang, **Advanced Computer Architecture**, Tata McGraw-Hill Education, 2003
2. David E. Culler, Jaswider Pal, **Parallel computer Architecture**, Gulf Professional Publishing, 1999
3. John L. Hennessy and David A. Patterson, **Computer Architecture: A Quantitative Approach**, Third Edition, Morgan Kaufmann, May 2002.
4. High-performance Computer Architecture, by Harold Stone Addison Wesley (1993) 3rd ed.
5. Parallel Computer Architecture: A Hardware/Software Approach David Culler and J.P. Singh with Anoop Gupta, Morgan Kaufmann (August 1998).

Course Name	**MOBILE COMPUTING**
Course Code	**CSN510**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Computer Networks, Communication systems**

Total Number of Lectures:42

COURSE OBJECTIVE
• To learn about the concepts and principles of mobile computing
• To explore both theoretical and practical issues of mobile computing
• To develop skills of finding solutions for mobile computing applications
• To perform research in upcoming technologies of mobile computing

LECTURE WITH BREAKUP	**NO. OF LECTURES**
INTRODUCTION TO MOBILE COMPUTING Introduction, Added Dimensions of Mobile Computing, Condition of the Mobile User, Architecture of Mobile Software Applications Introduction to Mobile Development Frameworks and Tools Workflow for Mobile Application Development, Techniques for Composing Applications. Java, Brew, Windows CE, Symbian, WAP, Android.	**(08)**
PUBLISHING & ACCESSING DATA IN AIR Pull and push based data delivery models, data dissemination by broadcast, broadcast disks, directory service in air, Energy-efficient indexing scheme for push based data delivery. File System Support for Mobility: Distributed file sharing for mobility support, Coda and other storage manager for mobility support	**08**
ROUTING AND COORDINATION Routing in MANETs, TORA, TORA-based computing protocols, Fundamental problems, Synchronization, Mutual exclusion, Coordinator election, Agreement problems, Termination in cellular systems and MANETs, Handling fundamental challenges in faulty distributed environments	**10**
MOBILITY AND LOCATION BASED SERVICES Introduction, Data Acquisition of Location Information, GIS, Location Information Modeling, Utilizing Location Based Services with Mobile Applications, Localization and Internationalization, latest development in Location based efforts. Context Aware Mobile Computing, context acquisition, context awareness	**08**
OVERVIEW OF MOBILE AND WIRELESS PROTOCOL Mobile Internet Protocol (MIP) version 6: MIPv6, Wireless Application Protocols: WAP – Architecture and Protocol Suite, Bluetooth – Architecture, Network, Protocols, Wireless LAN Protocols (WiFi): WiMAX – 802.16 and recent advances	**08**

COURSE OUTCOME
After completion of course, students would be able to:
• Grasp the concepts and features of mobile computing technologies and applications
• Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support
• Identify the important issues of developing mobile computing systems and applications
• Organize the functionalities and components of mobile computing systems into different layers and apply various techniques for realizing the functionalities

TEXTBOOK(s):
1. Theodore S. Rappaport, Wireless Communications: Principles and Practice, Second Edition, Prentice Hall, 2002.
2. Ivan Stojmenovic, Handbook of Wireless Networks and Mobile Computing, John Wiley & Sons, 2002.
REFERENCE(s):
1. Mohd. Ilyas & Imad Mahgoub, Mobile Computing Handbook, CRC Press/Aurbach Publications, ISBN 0-8493-1971-4, Boca Raton USA, 2005

2. Reza B'Far, Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Cambridge University, 2004
3. Reto Meie, Professional Android Application Development (Wrox Programmer to Programmer), Wrox, 2008
4. Axel Küpper, Location-Based Services: Fundamentals and Operation, Wiley, 2005.

Course Name	**DISTRIBUTED COMPUTING SYSTEMS**
Course Code	**CSN511**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Computer Architecture, Operating Systems**

Total Number of Lectures:42

COURSE OBJECTIVE
• To learn about the concepts and principles of distributed computing systems
• To explore both theoretical and practical issues of distributed computing systems
• To develop skills of finding solutions for distributed computing applications
• To perform research in upcoming technologies of distributed computing

LECTURE WITH BREAKUP	**NO. OF LECTURES**
DISTRIBUTED SYSTEMS MODELS Architectural models – Client-Server model, Thin Client, Mobile Devices. Software agents. Fundamental models – Interaction, Failure and Security models, Introduction to Distributed Computing Systems (DCS), DCS design goals, Transparencies, Fundamental issues	**06**
REMOTE INVOCATION, INTER-PROCESS COMMUNICATION AND FILE SYSTEM Communication between distributed objects, Remote Procedure Call, Remote Object Invocation, Events and notification, Message-and Stream-oriented communication, Message passing communication, Remote procedure call. Inter-process communication: Transaction communication, Group communication, Broadcast atomic protocols, File service architecture. Sun NFS. Recent advances. Case Studies: CORBA, DCOM	**12**
DISTRIBUTED COORDINATION AND AGREEMENT Clock Synchronization: Temporal ordering of events, Lamport's logical clocks, Vector clocks, Ordering of messages, Physical clocks, Global state detection, Distributed Mutual Exclusion, Leader Elections, Consensus and related problems. Introduction to fault-tolerance: Replication Management.	**12**
TRANSACTIONS AND CONCURRENCY CONTROL Fundamental principles, Transactions and nested transactions, Concurrency control in distributed transactions; Locks, Optimistic concurrency control, Timestamp ordering. Distributed deadlocks. Atomic commit protocols- 2PC and 3PC. Transaction recovery protocols, Distributed Snapshot and Global State Collection.	**12**

COURSE OUTCOME
After completion of course, students would be able to:
• Explain the need to design a distributed system and its desired properties
• List the principles underlying the functioning of distributed systems, describe the problems and challenges associated with these principles and evaluate the effectiveness and shortcomings of their solutions
• Design a distributed system that fulfills requirements for desired properties
• Describe and distinguish synchronization and concurrency control for a distributed computing system
• Design algorithms on various issues like mutual exclusion, fault-tolerance, commit etc.

TEXTBOOK(s):
1. Distributed Systems: Concepts and Design - George Coulouris, Jean Dollimore, and Tim Kindberg.
2. A.D. Kshemkalyani, M. Singhal, Distributed Computing: Principles, Algorithms, and Systems, ISBN: 9780521189842, Cambridge University Press, March 2011.
REFERENCE(s):
1. Distributed Systems: Principles and Paradigms - Andrew Tanenbaum and Maarten van Steen, Prentice Hall, 2007.
2. Distributed Algorithms by Nancy Lynch, Morgan Kaufman Press
3. Elements of Distributed Computing - Vijay K. Garg, Wiley, 2002.
4. Research Papers

Course Name	**SPECIAL TOPICS IN OPERATING SYSTEMS**
Course Code	**CSN512**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**UG level course in Operating Systems**

Total Number of Lectures:42

COURSE OBJECTIVE
• To study a modern operating system in detail.
• To study the architecture of distributed systems and real time operating systems.
• To introduce the theory and implementation of advanced operating systems

LECTURE WITH BREAKUP	**NO. OF LECTURES**
INTRODUCTION Functions of Operating system, Design approaches, Why advanced operating systems, Types of advanced operating systems, Synchronization mechanisms.	**(02)**
MULTIPROCESSOR OPERATING SYSTEMS Multiprocessor operating system, Multiprocessor system architecture, Processor scheduling and allocation, Memory Management. Process synchronization in multiprocessing/ multiprogramming systems, Inter-process communication and co-ordination.	**(07)**
DISTRIBUTED SYS	
Distributed operating system Distributed operating system characteristics, Network Structure, Communication: structure and Protocols, Design Issues.	**(05)**
Distributed File System Naming and transparency, Remote File Access, File Replication, Stateful vs Stateless Service.	**(04)**
Distributed Synchronization Event Ordering, Mutual Exclusion, Atomicity, Concurrency Control, Deadlock Handling, Election Algorithms.	**(05)**
SPECIAL PURPOSE SYSTEMS	
Real Time Operating System Scheduling mechanisms, Interrupts, Memory management, I/O & networking, Features of Real time Kernels.	**(07)**
Multi threading, Super threading and Hyper threading **CASE STUDIES** Case studies of contemporary operating systems, Open source software, LINUX, Mini OS.	**(03)** **(09)**

COURSE OUTCOME
After completion of course, students would be able to:

- Describe the architecture of distributed and real time operating systems.
- To describe, contrast and compare deferring structures for operating systems

REFERENCE(s):

1. M Singhal and NG Sivaratri, Advanced Concepts in Operating Systems, Tata McGraw, Hill Inc., 2001.
2. Silberschatz and P. Galvin, Operating System Concepts, VI edition, Addison Wesley 2004.
3. A.S. Tanenbaum, Distributed Operating System, Pearson Education Asia, 2001.
4. A. S. Tanenbaum and M. V. Steen, Distributed Systems – Principles and Paradigms, Second Edition, Pearson Prentice Hall, 2007.
5. Modern Operating Systems by A. Tanenbaum, 1992, Prentice-Hall.
6. Operating Systems Internals and Design Principles by William Stallings, 4 ed., 2001, Prentice-Hall

Course Name	**BUSINESS INTELLIGENCE**
Course No.	**CSN513**
Credits	**03**
L T P	**3 0 0**
Pre-requisites	

Total Number of Lectures:42

COURSE OBJECTIVE
1. The objective of this course is to aware students of the business intelligence, potential of today's data rich environment.
2. The objectives of this course are to provide students with comprehensive and in-depth knowledge of BI principles and techniques by introducing the relationship between managerial and technological perspectives.
3. The objective is also to enable students to have in depth knowledge of data capture, cleansing, validation, storage and analysis.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction to Business Intelligence Introduction to digital data and its types – structured, semi-structured and unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP), BI Definitions & Concepts, BI Framework, Data Warehousing concepts and its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI best practices	**(10)**
Basics of Data Integration (Extraction Transformation Loading) Concepts of data integration, needs and advantages of using data integration, introduction to common data integration approaches, Meta data - types and sources, Introduction to data quality, data profiling concepts and applications, introduction to ETL using Kettle	**(12)**
Introduction to Multi-Dimensional Data Modeling Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using Microsoft Excel	**(10)**
Basics of Enterprise Reporting A typical enterprise, Malcolm Baldrige - quality performance framework, balanced scorecard, enterprise dashboard, balanced scorecard vs. enterprise dashboard, enterprise reporting using MS Access / MS Excel, best practices in the design of enterprise dashboards	**(10)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Describe the components of a Enterprise data warehouse, Model the relational database required for an enterprise data warehouse.
2. To extract, cleanse, consolidated, and transform heterogeneous data into a single enterprise data warehouse and analyze data to generate information and knowledge that lead to informed decisions for businesses.
3. To perform "what-if" analysis in real time and will also be able to show how ERP business intelligence can be derived from data warehouses. Student will also be able to create standard reports for business users and derive insightful trends using data mining techniques.

TEXTBOOK(s):
1. Fundamentals of Business Intelligence by R. N. Parsad and Seema Acharya, Wiley
REFERENCE(s):
1. Business Intelligence by David Loshin
2. Business intelligence for the enterprise by Mike Biere

3. Business intelligence roadmap by Larissa Terpeluk Moss, Shaku Atre
4. An introduction to Building the Data Warehouse – IBM
5. Business Intelligence For Dummies – Swain Scheps
6. Successful Business Intelligence: Secrets to making Killer BI Applications by Cindi Howson
Information dashboard design by Stephen Few

Course Name	**SOFTWARE PROJECT MANAGEMENT**
Course Code	**CSN514**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**-**

Total Number of Lectures:42

COURSE OBJECTIVE
• To help students to learn the concept and importance of Software Project Management.
• To learn the Software Project Management Cycle and related activities.
• To understand software project planning, tracking and oversight in the implementation of the software project management process execution through collecting artifacts and metrics.
• Describe the project's current status, and risks using earned value data.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Project Management: Relationships Among Portfolio Management, Program Management, Project Management, and Organizational Project Management, Relationship Between Project Management, Operations Management, and Organizational Strategy, Business Value, Role of Project Manager, Organizational Influences and Project Life Cycle.	**(10)**
Project Management Processes: Project Management Process Groups, Project Integration Management, Project Scope Management.	**10**
Resources Management: Project Time Management, Project Cost Management, Human Resources Management.	**12**
Project Quality Management: Project Risk Management, Project Communications Management, Project Procurement Management, Project Stakeholders management.	**(10)**

COURSE OUTCOME
After completion of course, students would be able to:
• understand and practice the process of project management and its application in delivering successful Software projects;
• Evaluate a software project to develop the scope of work, provide accurate cost estimates and to plan the various activities;
• Understand and use of risk management analysis techniques that identify the factors that put a project at risk and to quantify the likely effect of risk on project timescales;
• identify the resources required for a project and to produce a work plan and resourceschedule;
• monitor the progress of a project and to assess the risk of slippage, revising targets or counteract drift;
• distinguish between the different types of project and follow the stages needed to negotiate an appropriate contract.

TEXTBOOK(s):
1. A GUIDE TO THE PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK® Guide) –Fifth Edition
REFERENCE(s):
1. Pankaj Jalote, Software Project Management in Practice, Pearson Education Asia (2002).
2. Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw Hill Publishing Company Ltd., New Delhi (2006) 3rd ed.
3. Tom Demarco, Controlling Software Project Management, Measurement, Prentice Hall, New Jersey (1982).
4. Watts S. Humphrey, Winning with Software An Executive Strategy, Pearson Education Asia (1998).
5. Philip Metzger, Managing A Programming Project, Prentice Hall, New Jersey (1983).
6. Tom Glib, Finzi Susannah, Principles of Software Engineering Management, Addison Wesley, England (2000).
7. Gopalaswamy Ramesh , Global Software Project Management, Tata McGraw Hill.

Course Name	**DESIGN OF EXPERIMENTS & RESEARCH METHODOLOGY**
Course Code	**CSN520**
Credits	**03**
LTP	**3 0 0**
Pre-Requisites	**--**

Total Number of Lectures:42

COURSE OBJECTIVE
• To understand some basic concepts of research and its methodologies
• To select and define appropriate research problem and Parameters
• To organize and conduct research in a more appropriate manner
• To understand statistical methods to formulate hypotheses
• To prepare a project proposal
• To write a research report

LECTURE WITH BREAKUP	**NO. OF LECTURES**
IDENTIFYING AND DEFINING RESEARCH PROBLEM Locating, Analyzing, stating and evaluating problem, technique in defining a problem	**(04)**
REVIEWING LITERATURE Need, Sources-Primary and Secondary, Purposes/scope of Review, Steps in conducting review	**(04)**
METHOD OF RESEARCH Research designs: Research design in case of exploratory research studies, research design in case of descriptive studies, Experimental Research and case study	**(04)**
PROCEDURE FOR WRITING A RESEARCH PROPOSAL Purpose, types and components of research proposal	**(05)**
PROCEDURE FOR WRITING A RESEARCH REPORT AND RESEARCH PAPER Audiences and types of research reports, Format of Research report and journal. Strategies for evaluating research, disseminating and utilizing research- An Overview, Guidelines for writing research paper	**(05)**
PROBABILITY DISTRIBUTIONS Discrete probability distribution, Continuous uniform distribution, Normal distribution, Areas under the normal curve, t-distribution, F-distribution, Chi-square distribution	**(06)**
SAMPLE ESTIMATION PROBLEMS Point estimation, Interval estimation, the estimation of mean, the estimation of Variances, Estimation of proportions	**(07)**
HYPOTHESIS Basic concepts concerning testing of hypothesis, procedure for hypothesis testing, important parametric tests: z-test,t-test,chi-squared test,F-test	**(07)**

COURSE OUTCOME
After completion of course, students would be able to:
• To define research and describe the research process and research methods

TEXTBOOK(s):
1. Probability and Statistics for Engineers and scientists, Walpole, Myers, Myers and Ye, 8th ed Pearson Education
2. Research methodology- methods and techniques, C.R. Kothari New Age International publisher
REFERENCE(s):
1. Adrian Wallwork ,English for writing research papers, Springer;
2. Charles X Ling, Quang Yang, Crafting your research Future , Morgan & claypool Publishers;

Course Name	**SOFTWARE TESTING TECHNIQUES**
Course Code	**CSN521**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Knowledge of Data Structures, Discrete Structures, Syntax and constructs of multiple**

:	**programming languages**

Total Number of Lectures:42

COURSE OBJECTIVE
• To help students to learn the concept and importance of Software Testing.
• To enable students to construct software that is reasonably easy to understand, modify, maintain and reliable.
• To develop a clear understanding and knowledge of foundations and techniques in Software Testing
• To provide an opportunity to learn strengths and weaknesses of various Software Testing Techniques used in industrial applications.

LECTURE WISE BREAKUP	**NO. OF LECTURES**
INTRODUCTION Terminology, Evolving nature of area, Errors, Faults and Failures, Correctness and reliability, Testing and debugging, Static and dynamic testing, Exhaustive testing: Theoretical foundations: impracticality of testing all data, impracticality of testing all paths, no absolute proof of correctness, Black Box Testing and White Box Testing.	**(10)**
SOFTWARE TESTING APPROACHES AND THEIR APPLICABILITY Software technical reviews; Software testing: levels of testing - module, integration, system, regression; Testing techniques and their applicability-functional testing and analysis, structural testing and analysis, error-oriented testing and analysis, hybrid approaches, integration strategies, transaction flow analysis, stress analysis, failure analysis, concurrency analysis, performance analysis; Proof of correctness; simulation and prototyping; Requirement tracing.	**(10)**
TEST GENERATION Test generations from requirements, Test generation paths, Data flow analysis, Finite State Machines models for flow analysis, Regular expressions based testing, Test Selection, Minimizations and Prioritization, Regression Testing, Web Testing.	**(08)**
OBJECT ORIENTED TESTING Object Oriented Testing Issues, OO Testing Methodologies, Analysis and Design Testing-UML Based, Class Testing, Integration Testing, Testing Hierarchies.	**(08)**
PROGRAM MUTATION TESTING Introduction, Mutation and mutants, Mutation operators, Equivalent mutants, Fault detection using mutants, Types of mutants, Mutation operators for C and Java.	**(06)**

COURSE OUTCOME
After completion of course, students would be able to:
• To develop testable software.
• Will develop testing psychology
• The importance of Software Testing in various phases of Software Development.
• To generate test cases effectively from Requirements, Design Models, Code etc.
• To generate test cases automatically.
• To apply various test cases to industrial applications.

TEXTBOOK(s):
1. Boris Beizer, Software Testing Techniques, John Wiley & Dreamtech.
REFERENCE(s):
1. William E. Perry, Effective Methods for Software Testing, John Wiley & Sons.
2. Aditya P. Mathur, Foundations of Software Testing, Pearson Education.
3. Glenford J. Myers, The Art of Software Testing, Wiley India Pvt. Ltd.
4. John D. McGregor & David A, A practical guide to testing object-oriented software, Addison- Wesley object technology series.

Course Name	**SPECIAL TOPICS IN SOFT COMPUTING**
Course Code	**CSN522**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Artificial Intelligence**

Total Number of Lectures:42

COURSE OBJECTIVE
• To introduce soft computing concepts and techniques and foster their abilities in designing.
• To implement soft computing based solutions for real-world problems.
• To give students knowledge of non-traditional technologies namely, fundamentals of artificial neural networks, fuzzy sets and fuzzy logic and genetic algorithms.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
ISSUES IN EXPERT SYSTEMS Knowledge representation, planning and acting in real world, semantic networks, predicate calculus, structural/casual networks, inference control, theorem proving, deduction, truth maintenance, planning, case study of one or more examples from Natural Language Processing, question answering, vision, expert systems	**(08)**
ARTIFICIAL NEURAL NETWORKS Concepts of Artificial Neural Networks and its basic mathematical model, simple perceptron, Feed-Forward Multilayer perceptron, Hopfield network, Self organizing network and recurrent network. **FUZZY LOGIC SYSTEM AND GENETIC ALGORITHM** Fuzzy logic, Fuzzification, Inferencing and defuzzification, Fuzzy Knowledge and rule bases, Fuzzy modeling and Control schemes, Genetic algorithm and detail algorithmic steps, Adjustment of free parameters, Search techniques like tabu search and ant-colony for solving optimization problems, Optimization techniques: PSO(Particle Swarm Optimization), ACO(Ant-colony Optimization), BVO(Binary Vector Optimization).	**(08)** **(16)**
APPLICATIONS GA application to power system optimization problem, Identification and control of linear and nonlinear dynamic systems, stability analysis of Fuzzy control systems.	**(10)**

COURSE OUTCOME
After completion of course, students would be able to:
• Identify and describe soft computing techniques and their roles in building intelligent machines
• Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
• Apply genetic algorithms to combinatorial optimization problems
• Apply neural networks to pattern classification and regression problems
• Evaluate and compare solutions by various soft computing approaches for a given problem.

REFERENCE(s):
1. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall.
2. David.E. Goldberg, ”Genetic Algorithms in search, optimization and Machine Learning”, Pearson Education India
3. Elaine Rich, Kevin Knight, “Artificial Intelligence”, Mc-Raw Hill.
4. Kosko.B. “Neural Networks and Fuzzy Systems”, Prentice Hall of India Pvt. Ltd., 1994.

Course Name	**DATA WAREHOUSING AND MINING**
Course Code	**CSN524**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Knowledge of Database Design and SQL**

Total Number of Lectures:42

COURSE OBJECTIVE
• Compare and contrast different conceptions of data mining as evidenced in both research and application.
• Explain the role of finding associations in commercial market basket data.
• Characterize the kinds of patterns that can be discovered by association rule mining.
• Describe how to extend a relational system to find patterns using association rules.
• Evaluate methodological issues underlying the effective application of data mining.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data Cube Technology, From Data Warehousing to Data Mining,	**03**
Data Preprocessing Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation, Online Data Storage.	**04**
Data Mining Primitives, Languages, and System Architectures Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems	**04**
Data Generalization and Summarization Data Generalization and Summarization- Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases.	**06**
Mining Association Rules in Large Databases Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.	**08**
Classification and Prediction Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.	**06**
Cluster Analysis Introduction Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis.	**06**
Mining Complex Types of Data Multidimensional Analysis and Descriptive Mining of Complex, Spatial Data Mining Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web, Graph Mining, Social Network Analysis, and Multi relational Data Mining.	**05**

COURSE OUTCOME
After completion of course, students would be able to:
• Demonstrate the knowledge gained through solving problems
• Use of data mining tools during Projects to build reliable products, the current demand of the industry.

TEXTBOOK(s):
1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER Harcourt India.
REFERENCE(s):
1. Data Warehousing in the Real World – SAM ANAHORY & DENNIS MURRAY. Pearson Ed. Asia.

2. Data Warehousing Fundamentals – PAULRAJ PONNAIAH. WILEY STUDENTEDITION
3. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL. WILEY STUDENTEDITION
4. Data Mining Introductory and advanced topics –MARGARET H DUNHAM. PEARSON EDUCATION

Course Name	**COMPUTER VISION**
Course Code	**CSN525**
Credits	**03**
LTP	**3 0 0**
Pre-Requisites	Mathematical Concepts for Computer Science

Total Number of Lectures:42

COURSE OBJECTIVE
• To provide understanding of techniques, mathematical concepts and algorithms used in computer vision to facilitate further study in this area.
• Software implementation of different concepts and techniques covered in the course.
• Focus on algorithms for image and video analysis based on color, shading, stereo, and motion.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
OVERVIEW Image acquisition, sampling and quantization, neighbors of pixels and connectivity, basic transformation, image enhancement, color image processing.	**06**
IMAGE FORMATION MODELS Monocular imaging system, Orthographic and Perspective Projection, Camera model and camera calibration, Binocular imaging systems.	**06**
IMAGE PROCESSING AND FEATURE EXTRACTION Image representations (continuous and discrete), Edge detection.	**06**
MOTION ESTIMATION Regularization theory, Optical computation, Stereo vision, Motion Estimation, Structure from motion.	**06**
SHAPE REPRESENTATION AND SEGMENTATION Deformable curves and surfaces, snakes and active contours, level set representations, Fourier and wavelet descriptors, Medical representations, Multi-resolution analysis.	**06**
OBJECT RECOGNITION Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition.	**06**
CASE STUDY Study of industrial applications, medical applications, etc. using computer vision methods.	**06**

COURSE OUTCOME
After completion of course, students would be able to:
• Understand the various edge detectors and Implement several image filtering algorithms.
• Understand the different ways that the shape of an object can be represented.
• Analyze image segmentation, representation, description, and recognition techniques

TEXTBOOK(s):
1. D. Forsyth, J. Ponce, “Computer Vision-A modern approach”, Prentice Hall of India
2. R. Gonzalez and R.E. Woods, “Digital Image Processing”, Pearson Education.
REFERENCE(s):
1. B.K.P Horn, “Robot Vision”, McGraw Hill.
2. E. Trucco and A. Verri, “Introductory techniques for 3D computer vision”, Prentice Hall

Course Name	ADVANCED TOPICS IN SOFTWARE ENGINEERING
Course Code	**CSN526**

Credits	**03**
LTP	**3 0 0**
Pre-Requisites	**-**

Total Number of Lectures:42

COURSE OBJECTIVE
• To make students aware of key issues in current software engineering research.
• To familiarize students with the state-of-the-art in terms of what problems can be solved and what are the current exciting challenges.
• To develop the necessary skills in students to enable them to contribute to the software engineering research community.
• To equip students with the skills and background to appreciate the contributions to software engineering research across the full range of material presented at the key international conferences in the field.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Formal Methods: Basic concepts, mathematical preliminaries, Applying mathematical notations for formal specification, formal specification languages, using Z to represent an example software component, the ten commandments of formal methods, formal methods- the road ahead.	**06**
Cleanroom Software Engineering: Agile Development, The cleanroom approach, functional specification, cleanroom design, cleanroom testing.	**05**
Component-Based Software Engineering: Engineering of component-based systems, the CBSE process, domain engineering, component-based development, classifying and retrieving components, and economics of CBSE, Software Reuse, Development for Reuse and Development with Reuse.	**08**
Client/Server Software Engineering: The structure of client/server systems, software engineering for c/s systems, analysis modeling issues, design for c/s systems, testing issues.	**06**
Web Engineering: The attributes of web-based applications, the WebE process, a framework for WebE, formulating/analyzing web-based systems, design for web-based applications, testing web-based applications, management issues.	**07**
Reengineering: Business process reengineering, software reengineering, reverse reengineering, restructuring, forward reengineering, economics of reengineering.	**05**
Software Changes Impact Analysis: Software Changes analysis, Software Clones Detection, Automated Test Cases Generation, Latest Trends. Various certifications in software engineering.	**05**

COURSE OUTCOME
After completion of course, students would be able to:
• Recognize the limitations of current approaches and systems and identify unsolved problems in Software Engineering
• Apply any implementations of recent developments e.g. tools, languages, techniques or frameworks etc.
• Build prototype or proof of concept tools to demonstrate and/or evaluate recent developments
• Read, review, and critically appraise software engineering research papers

REFERENCE(s):
1. Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill..
2. J. Bowan, Formal Specification and Documentation using Z - A Case Study Approach, International Thomson Computer Press.
3. Antoni Diller, Z., An Introduction to Formal Methods (second edition), Wiley, 2nd edition.
4. M. Dyer, The Cleanroon Approach to Quality Software Development, Wiley.
5. Prowell, S., Trammell, C.J. and Poore, J.H, Cleanroom Software Engineering: Technology and Process, Addison-Wesley, Massachusett.
6. Allen, Frost, Yourdon, Component-Based Development for Enterprise Systems: Applying the Select Perspectives, Cambridge University Press.

7. Zantinge and Adriaans, Managing Client/Server, Addison-Wesley.

Course Name	**ADVANCED MULTIMEDIA COMMUNICATION SYSTEMS**
Course Code	**CSN527**
Credits	**03**
LTP	**3 0 0**
Pre-Requisites	**-**

Total Number of Lectures:42

COURSE OBJECTIVE

- To describe the ways in which multimedia information is captured, processed, and rendered.
- To discuss the ways in which multimedia data is transmitted across networks
- To introduce Storage Media and Data Compression techniques.

LECTURES WITH BREAKUPS	NO. OF LECTURE
Introduction Motivation, evolution of multimedia, structure and components of multimedia, application domain, Internet and multimedia, hypertext, hypermedia, browser and helper application overview, user interface design issues.	**04**
Sound and Audio Technology Psychoacoustics: frequency and amplitude sensitivity of hearing, music and noise, stereo effects, masking; Frequency domain compression of analog signal, digitization of audio signal: sampling and coding, digital audio signal processing, architecture of sound card, MIDI: Interface, protocol and data format.	**08**
Image and Graphics Principles of raster graphics: visual display concept, resolution, colors and pallets, refresh rate and graphics accelerators; digital image representation and format, graphic drafting tools, image enhancement, digital still camera principles, file formats.	**07**
Video Technology and Animation Analog video principles and broadcast standards, CCD Camera, recording formats and standard; digital video principles, TV cards, frame grabber principles, IDTV and HDTV principles, History of animation, animation principles, animation techniques, shockwave animation, survey of animation tools and file formatS	**08**
Storage Media and Data Compression Magnetic media principles and storage density, principles of CD technology: CDROM, CDRW and CDDA format and principles, IDE, SCSI and USB interfaces to storage devices. Information theory based and frequency domain based compression, basic compression techniques (DPCM, RLE, Huffman Coding etc), JPEG/ISO, H261,H263, MPEG-1,2,4,7, DVI.	**08**
Authoring Tools and Metaphors Authoring tools: Productivity and Creativity, survey of authoring tools: book metaphor, Slideshow metaphor, time-line metaphor, network and icon metaphor.	**04**
Multimedia Document Interchange Formats Hypertext, HTML, MHEG, SGML, Open Document Architecture, Open Media Framework.	**03**

COURSE OUTCOME

After completion of course, students would be able to:

- Understand the relevance and underlying infrastructure of the multimedia systems.
- Understand core multimedia technologies and standards
- Understand various multimedia document interchange formats.

REFERENCE(s):

1. P.K. Andleighand K. Thakrar, Multimedia System Design
2. R. Steinmetz and K. Nashtedt, Multimedia Computing, Communication & Applications
3. Li and Drew, Fundamentals of Multimedia
4. F. Hulshall, Multimedia Communication
5. S. Fisher, Multimedia Authoring: Building and Developing Documents

Course Name	**HIGH PERFORMANCE COMPUTER ARCHITECTURE**
Course Code	**CSN528**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**UG level course in Computer Architecture**

Total Number of Lectures:42

COURSE OBJECTIVE
• The main objective of this course is to provide students with an understanding and appreciation of the fundamental issues and tradeoffs involved in the design and evaluation of modern computers.
• Topics will include, design and evaluation of instruction set architectures, pipelining techniques, multi-level memory hierarchies, superscalar processor design, multi-threading and multi-processing.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
REVIEW OF BASIC ORGANIZATION AND ARCHITECTURAL TECHNIQUES RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level, Classification of parallel architectures.	**(05)**
INSTRUCTION LEVEL PARALLELISM Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data, and control hazards, Overview of hazard resolution techniques, Vector Pipelining, Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution.	**(10)**
MEMORY HIERARCHIES Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.	**(07)**
THREAD LEVEL PARALLELISM Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multi-core architecture.	**(10)**
REVIEW OF MODERN PROCESSORS Pentium Processor: IA 32 and P6 micro architectures, ARM Processor.	**(10)**

COURSE OUTCOME
After completion of course, students would be able to:
• understand modern memory system design techniques including single and multi-level cache and virtual memory
• Understand processor pipeline issues, including pipeline hazards and associated mitigation techniques.
• understand the advanced scheduling techniques and instruction-level parallelism used in modern super-scalar

processors.
• understand relevant design issues for multiprocessor systems, including cache coherency issues

TEXTBOOK(s):
1. **Advanced Computer Architectures - A Design space approach**, Dezso Sima, Terence Fountain, Peter Kacsuk, Pearson Education 1997.
REFERENCE(s):
1. K Hwang, **Advanced Computer Architecture**, Tata McGraw-Hill Education, 2003
2. David E. Culler, Jaswider Pal, **Parallel computer Architecture**, Gulf Professional Publishing, 1999
3. John L. Hennessy and David A. Patterson, **Computer Architecture: A Quantitative Approach**, Third Edition, Morgan Kaufmann, May 2002.

Course Name	**FOUNDATIONS OF INFORMATION SECURITY**
Course Code	**CSN550**
Credits	**3**
LTP	**3 0 0**
Pre-Requisite	**Basic Concepts of Computer Science**

Total Number of Lectures:42

COURSE OBJECTIVE
1. To provide an understanding of principal concepts, major issues, technologies, and basic approaches in information security.
2. Master the key concepts of information security and how they "work."
3. Develop a "security mindset:" learn how to critically analyze situations of computer and network usage from a security perspective, identifying the salient issues, viewpoints, and trade-offs.
4. To provide the ability to examine and analyze real-life security cases.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction: Security mindset, Computer Security Concepts (CIA), Threats, Attacks, and Assets	**(5)**
Software Security: Vulnerabilities and protections, malware, program analysis	**(5)**
Practical Cryptography: Encryption, authentication, hashing, symmetric and asymmetric cryptography, Digital Signatures and Certificates	**(8)**
Network Security: Network security issues, Sniffing, IP spoofing, Common threats, E-Mail security, IPSec, SSL, PGP, Intruders, Virus, Worms, Firewalls-need and features of firewall, Types of firewall, Intruder Detection Systems.	**(10)**
Cyber Security: Cyber Crime and security, Security tools, Introduction to Digital Forensic, OS fingerprinting, TCP/IP stack masking, Social Engineering.	**(8)**
Applications and special topics: Web application Security, Privacy and Anonymity, public policy	**(6)**
Laboratory: The lab work will be based on the setting up of network firewalls, Intruder Detection systems, security and performance analysis of basic cryptography algorithms and digital signature algorithms, tcpdump.	

COURSE OUTCOME
After completion of course, students would be able to:
1. Evaluate vulnerability of an information system and establish a plan for risk management.
2. Demonstrate basic principles of Web application security
3. Evaluate the authentication and encryption needs of an information system.
4. Demonstrate how to secure a network
5. Evaluate a company's security policies and procedures

TEXTBOOK(s):
1. **Computer Security: Principles and Practice**, William Stallings; Lawrie Brown
REFERENCE(s):
1. Introduction to Computer Security, 2004 Matt Bishop, Addison-Wesley, ISBN 0-321-24744-
2. Buchmann J. A., Introduction to Cryptography, Springer Verlag (2001).
3. Stallings William, Cryptography and Network Security, Pearson Education (2006).
4. Schneier Bruce, Applied Cryptography, John Wiley and Sons (1996).
5. Britz M., Computer Forensic and cyber crime, Upper Saddle River, Prentice Hall (2003).

Course Name	**COMPUTATIONAL THEORY AND CRYPTOGRAPHY**
Course Code	**CSN551**
Credits	**3**
L T P	**3 0 0**
Pre-Requisites	**Basic Concepts of Computer Science & Algorithms**

Total Number of Lectures:42

COURSE OBJECTIVE
1. Provide an introduction to basic number theory, with a focus on computational aspects with applications in cryptography.
2. Understand basic design principals of symmetric and asymmetric cryptography, what makes certain designs weak and why key lengths are not always indicators of a systems security;
3. Learn how many standard cryptanalytic attacks work and thereby how to avoid common design flaws;
4. Specify how cryptographic tools are applied to achieve privacy and authentication
5. To understand hash functions and existing techniques like AES, RSA, and Discrete Log.
6. To emphasize algorithmic complexity and understand security vs performance trade off.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Foundations Substitution Ciphers and Transposition Cipher, Block cipher, Stream cipher.	**(04)**
Cryptographic Protocols Introduction to Protocols, Communications using Symmetric Cryptography, One-Way Functions, Communications using Public-Key Cryptography, Digital Signatures, Digital Signatures with Encryption, Random and Pseudo-Random Sequence Generation, Basic Protocols: Key Exchange, Authentication, Authentication And Key Exchange, Formal Analysis Of Authentication And Key-Exchange Protocols, Multiple-Key Public-Key Cryptography.	**(08)**

Cryptographic Techniques **Key Length & Management:** Symmetric Key Length, Public-Key Key Length, Comparing Symmetric And Public-Key Key Length, **,** Generating Keys, Nonlinear Keyspaces, Transferring Keys, Verifying Keys, UPDATING KEYS, Storing Keys, Backup Keys.	**(10)**
Cryptographic Algorithms Mathematical Theory, NUMBER THEORY, FACTORING, Prime Number Generation, Discrete Logarithms in a Finite Field, Data Encryption Standard: Description of DES, Security of DES, Differential And Linear Cryptanalysis, Design Criteria, DES Variants, DES modes of operation, Other Stream Ciphers and One-Way Hash Functions RC4, One-Way Hash Functions, MD5, Secure Hash Algorithm (SHA), Message Authentication Codes	**(08)**
Public-Key Algorithms Background, RSA, Elliptic Curve Cryptosystems, Digital Signature Algorithm, Key-Exchange Algorithms: DIFFIE-HELLMAN	**(08)**
Implementations PRETTY GOOD PRIVACY (PGP), SMART CARDS	**(04)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Students should be able to apply the basic rules of public key and symmetric encryption for practical cryptographic problems.
2. Be able to demonstrate the design and use of hash functions, digital signatures, and key distribution with a wide range of key types.
3. Be able to understand the current popular techniques of AES and RSA, digital signatures and key establishment protocols.
4. Given a problem in cryptography, be able to design an algorithm to implement the solution to that problem.

TEXTBOOK(s)
1. Applied Cryptography protocols, algorithms, and source code in C, Second Edition, Bruce Schneier, John Wiley & Sons, 1996.
REFERENCE(s)
1. Handbook of Applied Cryptography, by Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, CRC Press ISBN: 0-8493-8523-7 , October 1996.

Course Name	**CYBER CRIMES & RELATED IT LAWS**
Course Code	**CSN556**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Network security**

Total Number of Lectures:42

COURSE OBJECTIVE
1. Examine how the online world has borne new crimes and law enforcement response.
2. Investigate how the computer has become both a target of attack and a tool for criminal activity
3. Analyze the usage of internet as a tool of crime in cyber space
4. Explore through various case studies the number of emerging cybercrimes (cyber-stalking, hacking, and attacks to critical infrastructure), and also explores how old crimes are affected in new mediums
5. Gain insights to application of IT Laws for different types of cyber crimes

LECTURE WITH BREAKUP	**NO. OF LECTURES**

Information Technology Law Digital and Electronic signatures, Penalties, Compensation & Adjudication, Offences, Liability of Intermediaries, Real World Cases, Sample documentation.	**(05)**
Use of internet in cybercrime How does the Internet work, Email, Web Browsers, Configuring an FTP Server, Configuring a DNS Server, Configuring a Web Server.	**(05)**
Types of Cyber Crimes Cyber Vandalism (Hacking), Cyber Stalking, Denial of Service, Attack, Dissemination of Offensive Material, Internet Frauds, Theft of Telecommunication services, Software Piracy, Dissemination of Viruses & worms, Phishing, Cell Phone cloning, Cyber Terrorism.	**(08)**
Real World Cyber Crime Investigations Hacker Methodology, Malicious code, Basics of Cyber Crime Investigation, Investigating Emails, Investigating Server Logs, Password Breaking, Investigating Intellectual Property Crimes, Investigating Financial Crimes, Investigating Digital Signature Crimes, Legal Issues, Sample Documentation, Guidelines for Real World Investigations, Source code theft case, Cyber Sabotage case, Lottery fraud case, Accounting fraud case, Digital Signature Fraud case, Investigation Guidelines	**(10)**
IT Act 2000 & IT Amendment Act 2008 Introduction, Digital Signature, Secure Electronic records and secure digital signatures, Digital Signature Certificates, Offences covered under IT Act 2000, Major Amendments in IT Act	**(08)**
Case Studies on International Cyber Crime Law India, Australia, Canada, Japan, Malaysia, Singapore, United Kingdom (UK), United States of America (USA).	**(06)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Analyze various types of cyber crime and formulate real world cyber crime investigations
2. Understand the unique challenges posed to law enforcement agents, policy makers and prosecutors
3. Ability to find solutions in cyber crime investigations, evidence and applicable law for real world case studies
4. Analyze the software tools and methods currently available for finding illegal activities on computer disks and in computer networks.
5. Analyze the criminal activity on the Internet and propose available tools to prevent such activity.

TEXTBOOK(s):
1. Handbook of Cyber Laws, by Vakul Sharma ,Macmillan.
REFRENCE(S):
1. Articles in various journals and conference proceedings

Course Name	**NETWORK SECURITY**
Course Code	**CSN571**
Credits	**3**
LTP	**3 0 0**
Pre-Requisite	**Computer Networks and Foundations of Information Security**

Total Number of Lectures:42

COURSE OBJECTIVE
1. Investigation of core security technologies and security policies to mitigate risks.
2. Gain an understanding of network perimeter security design principles
3. Gain an understanding of free/ commercial security tools and their applications and develop the security solution for a given application/scenario

4.	Ability to review procedures for installation, troubleshooting and monitoring of network devices to maintain integrity, confidentiality and availability of data and devices
5.	Knowledge of the technologies that underpin the deployment and maintenance of a secure network.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Packet Filtering How Packet Filtering Works, TCP and UDP Ports, TCP's Three-way Handshake, Router as a Packet Filter, An Alternative Packet Filter: IP Chains, Egress Filtering, Industry standard protocols: working of router protocol, how they work and how to drive them.	**(05)**
Stateful & Proxy Firewalls Working of Stateful Firewall, The Concept of State, Stateful Filtering and Stateful Inspection, Fundamentals of Proxying, Pros and Cons of Proxy Firewalls, Types of Proxies, Tools for Proxying	**(05)**
Security Policy Firewalls Are Policy, How to Develop Policy, Perimeter Considerations	**(02)**
Virtual Private Networks VPN Basics, Advantages and Disadvantages of VPNs, IPSec Basics	**(03)**
Network Intrusion Detection & Prevention Systems Network Intrusion Detection Basics, the Roles of Network IDS in a Perimeter Defense, IDS Sensor Placement, IPS, IPS Limitations, NIPS, Host-Based Intrusion Prevention Systems, Case Studies	**(04)**
Host Hardening & Defense Components The Need for Host Hardening, Removing, Disabling or Limiting Access of Unnecessary Programs or Data and Configuration Files, Controlling User and Privileges, hardening hosts and the Perimeter, Antivirus Software, Host-Based Firewalls, Host-Based Intrusion Detection, Challenges of Host Defense Components, Preventing TCP/UDP exploits from DoS attacks.	**(08)**
Designing a Secure Network Perimeter The Role of a Router, The Router as a Perimeter & Security Device, Router Hardening, Fundamentals of Secure Perimeter Design, Gathering Design Requirements, Design Elements for Perimeter Security, Separating Resources, Security Zones, Common Design Elements, VLAN-Based Separation	**(07)**
Maintaining a Security Perimeter System and Network Monitoring, Incident Response, Accommodating Change	**(04)**
Network Log Analysis The Importance of Network Log Files, Log Analysis Basics, Analyzing Router Logs, Analyzing Network Firewall Logs, Analyzing Host-Based Firewall and IDS Logs	**(04)**

COURSE OUTCOME	
After completion of course, students would be able to:	
1.	Gain insight to fundamentals of network vulnerabilities and attacks.
2.	Demonstrate the skill to penetrate service vulnerability.
3.	Implement, monitor and maintain a secure networks consisting of network devices such as routers, switches and firewalls.
4.	Gain understanding in the role of AAA and IPSec in securing networks.
5.	Design network policies in securing the perimeter of a network
6.	Learn to design/develop/ implement security policies, strategies and the security solution for a given use case.

TEXTBOOK(s):
1. **Inside Network Perimeter Security,Second Edition, Stephen Northcutt; Lenny Zeltser; Scott Winters; Karen Kent; Ronald W. Ritchey, Sams**
REFERENCE(s):
1. Network Perimeter Security: Building Defense In-Depth ,Cliff Riggs, Proteris Group, Waterbury, Vermont, USA
2. W. Stallings, Network Security Essentials (3rd Edition), Prentice-Hall, 2007
3. W. R. Stevens, TCP/IP Illustrated, Vol. 1: The Protocols, Addison-Wesley, 1993
4. D. E. Comer, Internetworking with TCP/IP, Vol.1 (4th Edition), Prentice Hall, 2000
5. R. Oppliger, Internet and Intranet Security (2nd edition), Artech House, 2002
6. W. R. Cheswick and S.M. Bellovin, Firewalls and Internet security (2nd edition), Addison-Wesley, 2003.

Course Name	**BIOMETRIC SECURITY**
Course Code	**CSN580**
Credits	**03**
LTP	**3 0 0**
Pre-Requisites	**Digital Image Processing**

Total Number of Lectures:42

COURSE OBJECTIVE
1. Cover a broad range of approaches to biometrics reflecting both fundamental principles and the current state-of-the-art practices.
2. To develop an understanding of the fundamental components common to all biometric systems.
3. To develop the student's ability to design, implement, test and evaluate biometric systems that conform to international standards.
4. To develop the students ability to carry out research in biometrics

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Biometrics Introduction Benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, comparison of various biometric traits, selecting a biometric for system, 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.	**07**
Physiological Biometric Technologies Fingerprints: Technical description, characteristics, Competing technologies, strengths, weaknesses and deployment. Facial scan: Technical description, characteristics, weaknesses and deployment. Iris scan: Technical description, characteristics, strengths, weaknesses and deployment. Retina vascular pattern: Technical description, characteristics, strengths, weaknesses and deployment. Hand scan: Technical description, characteristics, strengths, weaknesses and deployment.	**(15)**
Behavioral Biometric Technologies Handprint Biometrics, Signature and handwriting technology: Technical description, classification, keyboard /keystroke dynamics, Voice: data acquisition, feature extraction, characteristics, strengths, weaknesses, deployment	**(10)**
Multi biometrics Multi-modal biometric Systems: Face and Hand geometry, Fingerprint and iris recognition etc, Multimodal fusion techniques- score fusion, z-norm fusion etc., Normalization techniques	**(05)**
Biometric Security Modals Sensor level security, database security, template security techniques, Channel level security, various	**(05)**

remedial solutions available.	

COURSE OUTCOME
After completion of course, student would be able to:
1. Modern biometric technologies and the generic components of a biometric system.
2. Pattern recognition and feature extraction in biometrics, Voice and face recognition systems.
3. Select the most appropriate biometric for a given application.
4. Work with signal and image acquisition systems, Deploying biometric systems.
5. Defend proposed biometric systems for a given real world problem and analyze its security aspects.

TEXTBOOK(s):
1. Anil K. Jain, Michigan State University, USA, Patrick Flynn University of Notre Dame, USA, Arun A. Ross West Virginia University, USA , "Handbook of Biometrics", 2008.
REFERENCE(s):
1. Implementing Biometric Security (Wiley Red Books)by John Chirillo, Scott Blaul.
2. Anil K. Jain Michigan State University, E. Lansing, Michigan and Ruud Bolle and Sharath Pankanti IBM, T.J. Watson Research Center Yorktown Heights, New York Kluwer Academic ," Biometrics Personal Identification in Networked Society", 2002 Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow.
3. Articles in various journals and conference proceedings.

Course Name	**CLOUD COMPUTING & SECURITY**
Course Code	**CSN581**
Credits	**03**
LTP	**3 0 0**
Pre-Requisites	**Foundations of Information Security**

Total Number of Lectures:42

COURSE OBJECTIVE
1. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
2. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
3. The student will also learn how to apply trust-based security model to real-world security problems.
4. The course provides guidance for building private Clouds and a lab exercise where the student will implement a public cloud using a 3rd party provider's interface

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction to Cloud Computing Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing	**(03)**
Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model	**(07)**
Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise	
Security Issues in Cloud Computing Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security,	**(07)**
Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management	**(05)**
Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS,	**(05)**

PaaS, IaaS	
Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	**(08)**
Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-As-a-[Cloud]	**(06)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider
4. Apply trust-based security model to different layers in the infrastructure stack
5. Distinguish between cloud providers and 3rd party managed service providers

TEXTBOOK(s):
1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
REFERENCE(s):
1. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009
2. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, Publisher: O'Reilly Media; 1 edition (April 10, 2009), ISBN-10: 0596156367, ISBN-13: 978-0596156367
3. Cloud Computing Bible by Barrie Sosinsky (Jan 11, 2011), Wiley Publication, ISBN-10: 0470903562
4. Introduction to Cloud Computing by Timothy Chou (Dec 27, 2010)

Course Name	**MOBILE AND WIRELESS NETWORK SECURITY**
Course Code	**CSN583**
Credits	**3**
LTP	**3 0 0**
Pre-Requisites	**Network Security, Cryptographic Technique, Mobile Communication, Computer Networks**

Total Number of Lectures:42

COURSE OBJECTIVE
1. To learn why wireless is different with perspective of designing security schemes.
2. Learn security requirement and analyze compatible solutions for wireless environment.
3. Creatively analyze mobile and wireless networks for threats and distinct attacks
4. Learn security design aspects in different wireless environment MANET, WLAN, VANET, WiMAX, GSM/CDMA etc.
5. Explain the vulnerabilities introduced into an infrastructure by wireless and cellular technologies.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Introduction to Mobile and Wireless Networks Mobile cellular networks : Advanced Generations: 1G onwards, IEEE wireless networks : IEEE 802.11, IEEE 802.15, IEEE 802.16, Mobile Internet networks : Macro mobility, Micro mobility, Personal mobility and SIP, identify based mobility, NEMO and MANET networks	**(05)**
Vulnerabilities of wired and wireless networks Security in the digital age, Threats and risks to telecommunications systems, From wireline vulnerabilities of vulnerabilities in wireless communications	**(04)**

Fundamental Security Mechanisms Basics on Security, Secure communication protocols and VPN implementation, Authentication, Access control	**(04)**
Wi-Fi security Dedicated architectures Hot spot architecture : captive portals, Wireless intrusion detection system(WIDS), Wireless honeypots	**(04)**
Multimedia Content watermarking Robust watermarking: a new challenge for the information society, Different constraints for different types of media	**(04)**
Bluetooth Security Bluetooth technical specification, Bluetooth security	**(02)**
Wi-Fi Security Attacks on wireless networks, security in the IEEE 802..11 standard, Security in 802.1x, Security in 802.11i, Authentication in wireless networks, Layer 3 security mechanisms	**(05)**
Security in Mobile Telecommunication Networks Signaling, security in the GSM, GPRS security, 3G security	**(05)**
Security of Downloadable Applications Opening the handset, security policy, The implementation of a security policy, Execution environments for active contents, Validation of active contents, Detection of attacks	**(05)**
Wireless Sensor Network Security Introduction, Attacks on wireless sensor network and counter-measures, Preventive mechanism : authentication and traffic, Case study : centralized and passive intruder detection	**(04)**

COURSE OUTCOME
After completion of course, students would be able to:
1. Architect a secure wireless network infrastructure for their organization, including strong encryption and centralized authentication;
2. Gain insight to the hackers threats and the major techniques used against hacking wireless networks;
3. Master hacking and vulnerability assessment tools to assess the security of wireless networks, including cracking WEP and WPA security;
4. Identify (and fix) vulnerabilities and mis-configurations in wireless network technologies;

TEXTBOOK(s):
1. Wireless and Mobile Network Security-Security basics, Security in On-the-shelf and emerging technologies,Hakima Chaouchi, Maryline Maknavicius, ISBN: 9781848211179, June 2009, Hardback
REFERENCE(s):
1. Mobile and Wireless Network Security and Privacy, Springer, ISBN: 0387710574, edition 2007