SCHOOL
OF
INFORMATION AND COMMUNICATION TECHNOLOGY

COURSE STURCTURE

M. TECH.

COMPUTER SCIENCE

GAUTAM BUDDHAUNIVERSITY
GAUTAM BUDH NAGAR, GREATER NOIDA
2015-2016

M. Tech. CSE **Effective from: 2015 -2016**

SEMESTER I

Sr. No.	Courses Code	Courses	L-T-P		Credits
1	CS521	Advanced Data Base Management System	3-1-0	C1	4
2	CS523	Advanced Computer Architecture	3-1-0	C2	4
3	CS525	Intelligent System Design	3-1-0	C3	4
4	CS527	Research Techniques in ICT	3-1-0	SEC1	4
5	---	Open Elective-1	3-0-0	OE1	3
6	CS581	Advanced Data Base Management System Lab	0-0-3	C4	2
7	CS585	Intelligent System Design Lab	0-0-3	C5	2
8	GP	General Proficiency	------	NCC	
Total Credits					**23**
Total Contact Hours				**15-4-6 =**	**25**

Open Electives-I

1. **CH503 Patent Laws and IPR Issues**
2. **HU501 Advanced Course in Professional Communication**

SEMESTER – II

Sr. No.	Courses Code	Courses	L-T-P		Credits
1		Generic Elective	3-1-0	GE1	4
2	CS532	Advanced Software Engineering	3-0-0	C6	3
3	CS574	Advanced Data Structure and Algorithm Design	3-0-0	C7	3
4	CS576	Advanced Operating Systems	3-0-0	C8	3
5		**Elective-1**	3-0-0	DSE1	3
6	CS582	Advanced Data Structure & Algorithm DesignLab	0-0-3	C9	2
7	CS592	Major Project	0-0-10	DP1	5
8	GP532	General Proficiency	------	NCC	0
Total Credits					**23**
Total Contact Hours				**15-1-13 =**	**31**

Electives (1)		
1	CS578	Cloud Computing
2	EC531	Advanced Digital Communication Systems
3	CS586	AI and Neural Networks
4	CS588	Advanced Internet Technology
5	CS590	High Speed Networks
6	CS564	Soft Computing Techniques
7	CS592	Advanced Java Programming
9	CS 596	Wireless Mobile Networks

10	CS 598	Embedded Linux
11	CS552	Any skill based course by NSDC*credits will be decided when the course is run.

Generic Elective (GE2)

1. MA 402 Modeling and Simulation
   MA416 Probability and Stochastic Process

SEMESTER III

Sr. No.	Courses Code	Courses	L-T-P		Credits
1	CS695	Computer Security	3-0-0	C10	3
2	CS673	Computer Networks and Distributed Systems	3-0-0	C11	3
3		**Electives –2**	3-0-0	DSE2	3
4	CS655	Industrial Practices in Software Engineering	2-0-0	DSE3	2
5	CS683	Industrial Practices in Software Engineering	0-0-6	DSE4	3
6	CS691	Dissertation Part - I	0-0-14	DP2	7
7	GP631	General Proficiency	------	NCC	0
		Total Credits			**21**
		Total Contact Hours		**12-0-17 =**	**29**

Electives (2)		
1	CS641	Aspect-Oriented Software Engineering
2	CS675	Multimedia and Computer Graphics
3	CS677	Information Theory and Coding
4	CS679	Fuzzy Set Theory
5	CS693	Parallel Computing
6	EC635	Mobile Computing
7	CS 680	Analytical Models for computing System
8	CS 697	Ad-Hoc Networks
9	CS671	Image Processing and Pattern Recognition
10	CS685	Computer Networks and Distributed Systems Lab

SEMESTER IV

Sr. No.	Courses Code	Courses	L-T-P		Credits
1	CS690	Dissertation Part – II	------	DP3	23
2	GP632	General Proficiency	------	NCC	
		Total Credits			**23**

GRAND TOTAL CREDITS = 90

ADVANCED DATA BASE MANAGEMENT SYSTEM			
Course Code:	**CS521**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION TO DATABASE DESIGN

Entities, Attributes, Entity Sets, Relationships, Key Constraints, Participation Constraints, Weak Entities, UML Class Diagrams, Subclasses, Superclasses, Inheritance,Specialization, Generalization, Constraints and Characteristics of Specialization and Generalization Hierarchies, Modeling of UNION Types Using Categories, Representing Specialization and Generalization In UML Class Diagrams, Data Abstraction, Knowledge Representation and Ontology Concepts.

UNIT II DATABASES DESIGN THEORY

Problems Caused by Redundancy, Decompositions, Problems Related to Decomposition, Reasoning About FD's, FIRST, SECOND, THIRD Normal Form, BCNF, Forth Normal Form, Lossless Join Decomposition, Dependency Preserving Decomposition, Schema Refinement in Data Base Design, Multi Valued Dependencies.

UNIT III OBJECT- ORIENTED, PARALLEL AND DISTRIBUTED DATABASES

Overview of Object-Oriented Concepts, Object Identity, Object Structure, Type Constructor, Encapsulation of Operations, Methods and Persistence; Architectures For Parallel Databases, Parallel Query Evaluation, Parallelizing Individual Operations, Sorting Joins, Distributed Database Concepts, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Query Processing in Distributed Databases, Concurrency Control and Recovery in Distributed Databases.

UNIT IV DATABASES ON THE WEBANDSEMI–STRUCTURED DATA

Web interface, XML, structure of XML data, querying XML data, storage of XML data, XML applications, semi-structured data model, indexes for text data.

UNIT V ENHANCED DATA MODELS FOR ADVANCED APPLICATIONS

Active database concepts, temporal database concepts, spatial databases: concept and architecture, deductive databases and query processing, mobile databases, Geographic Information Systems (GIS).

Text Books:

1. Elmsari and Navathe, Fundamentals of Database Systems,
2. Ramakrishnan and Gehrke, Database Management Systems,

References Books:

3. Korth, Silberschatz, Sudarshan, Database System Concepts,
4. Rob and Coronel, Database Systems: Design, Implementation and Management,
5. Date and Longman, Introduction to Database Systems,

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ADVANCED COMPUTER ARCHITECTURE			
Course Code:	**CS523**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I

Introduction to parallel processing: parallelism in uniprocessor system, basic uniprocessor architecture, parallel processing mechanism, balancing of sub system bandwidth, multiprogramming and time sharing, parallel computer structures, pipeline computers, array computers, multiprocessor systems, dataflow computer concept, architectural classification scheme: multiplicity of instruction-data streams, serial versus parallel processing, parallelism versus pipelining, parallel processing applications, productive modeling simulation, engineering design and automation.

UNIT II

Principles of pipelining and vector processing: pipelining- an overlapped parallelism, principles of linear pipelining, clock period, efficiency, throughput, classification of pipeline processors, general pipeline and reservation tables.

UNIT III

Principles of designing pipeline processors: effect of branching, data buffering and bussing structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, reservation and latency analysis, collision free scheduling, state diagram, greedy cycle, pipeline schedule optimization, pipeline throughput, pipeline efficiency.

UNIT IV

Structure and algorithm for array processors: SIMD array processor, SIMD computer organization, inter –PE communication, SIMD interconnection network, static versus dynamic networks, cube interconnection network, shuffle-exchange omega networks, parallel algorithms and SIMD matrix multiplication.

UNIT V

Multiprocessor architecture and scheduling: functional structure, loosely coupled and tightly coupled multiprocessor, deterministic scheduling strategy, deterministic scheduling model, control flow versus data flow computer, data flow graphs and languages.

References Books:

1. Kai Hwang, “Advanced Computer Architecture”, Tata McGrawHill Edition
2. Kai Hwang and Faye A. Briggs, “Computer Architecture and Parallel Processing”, McGraw-Hill International Edition
3. Richard Y. Kain, “Advanced Computer Architecture: a Systems Design”, Prentice Hall.
4. James M. Feldman, Charles T. Retter, “Computer architecture: a designer's Text Based on a generic RISC”, McGraw-Hill
5. Jurij Silc, Borut Robic, Theo Ungerer, “Processor Architecture: From Dataflow to Superscalar and Beyond”, Springer.
6. Hennessy and Patterson, “Computer Architecture: A Quantitative Approach”, Elsevier.
7. Dezso and Sima, “Advanced Computer Architecture”, Pearson.
8. Quinn, “Parallel Computing: Theory & Practice”, TMH.
9. Quinn, “Parallel Programming in C with MPI and Open MP”, TMH

INTELLIGENT SYSTEM DESIGN			
Course Code:	**CS525**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I
INTRODUCTION TO ARTIFICIAL INTELLIGENCE
Basic concept of artificial intelligence (AI), history of AI, AI and consciousness, weak and strong AI, physical symbol system hypothesis, comparison of computer and human skills, practical systems based on AI, development of logic, components of AI.

UNIT II
PROBLEM SOLVING THROUGH AI
Defining problem as state space search, analyzing the problem, representing the problems from AI viewpoint, production system, developing production rules, characteristics of production system, algorithm for problem solving using AI technique.

UNIT III
SEARCH TECHNIQUES
Use of search in AI problem solution, blind search techniques, heuristic search techniques, concept of heuristic knowledge, designing of the heuristic function, types of heuristic search techniques: generate and test, best first search, problem reduction using AND – OR graph, local search technique, branch and bound search, memory bounded search technique, local beam search, properties of heuristic search techniques, overestimation and underestimation of heuristic function, hill climbing search, simulated annealing search, constraint satisfaction, means ends analysis.

UNIT IV
INTRODUCTION TO LOGIC
Introduction, propositional calculus, syntax of propositional calculus, semantics of propositional calculus, well formed formula, properties of statements, inferencing of propositional logic, predicate logic, syntax of predicate logic, semantics of predicate logic, representation of facts First Order Predicate Logic (FOPL), inferencing in predicate logic, concept of resolution, resolution algorithm, skolemization, Types of resolution, unit resolution, binary resolution.

UNIT V
PROLOG and LISP
Basic concept of programming languages related to artificial intelligence problems, concept of programming in Logic, basic prolog constructs, atoms, defining the rules, writing small programs in prolog, concept of list processing, basic LISP constructs, writing functions in LISP, some simple programs of LISP.

Reference books:

1. Artificial Intelligence, Elanie Reich: Tata mcgraw Hill publishing house, 2008.
2. Artificial intelligence, Peterson, TataMcGraw Hill, 2008.
3. Artificial intelligence, Russel and Norvig, Pearson Printice Hall Publication, 2006.
4. Artificial Intelligence, Winston, PHI publication, 2006.

RESEARCH TECHNIQUES IN ICT			
Course Code:	**CS527**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION TO RESEARCH TECHNIQUES

Meaning of research, objectives of research, motivation in research, types of research (Introduction to experimental test bed, algorithmic research, simulation research, mathematical modeling approach), characteristics and prerequisites of research, significance of research, research process, sources of research problem, criteria of identifying the problem, necessity of defining the problem, errors in selecting research problem, technique involved in defining the problem, report and paper writing.

UNIT II DATA ANALYSIS ANDSTATISTICAL TECHNIQUES

Data and their analyses, quantitative methods and techniques, Measure of central tendency, measures of variation, frequency distribution, analysis of variance, methods, Correlation analysis, regression analysis, time series and forecasting, introduction to discriminant analysis, factor analysis, cluster analysis, conjoint analysis, probability distribution, binomial distribution, poisson distribution, uniform distribution, exponential distribution, and normal distribution, sampling methods, test of hypothesis.

UNIT III MATHEMATICAM MODELING

Steps of modeling, operations research models like queuing theory, stochastic processes, application of models, conceptual framework development and validation techniques, optimization techniques.

UNIT IV ALGORITHMIC RESEARCH

Algorithmic research problems, types of algorithmic research, types of solution procedure, steps of development of algorithm, steps of algorithmic research, design of experiments,

UNIT V SIMULATION ANDSOFT COMPUTING TECHNIQUES

Introduction to soft computing, artificial neural network, genetic algorithm, fuzzy logic and their applications, tools of soft computing, need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, output analysis, data simulation packages like MATLAB, NS2, ANSYS, Cadence.

Reference Books:

1. Research Methodologies, R. Panneerselvam, Prentice Hall, 2007.
2. Research in Education, Best John V. and James V Kahn, Wiley eastern, 2005.
3. Elements of Educational Research, Sukhia, S.P., P.V. Mehrotra, and R.N. Mehrotra, PHI publication, 2003.
4. Methodology of Research Education, K. Setia, IEEE publication, 2004.
5. Research methodology, Methods and Techniques, Kothari, C.R., 2000.

ADVANCED DBMS LAB			
Course Code:	**CS581**	**Credits:**	**2**
No. of Lectures (Hrs/Week):	**3**		
Total No. of Lectures:	**10**	**End Sem Exam Hours:**	**2**

Programs/Experiments List:

1. Introduction to MySQL, Postgre Sql, Microsoft Sql softwares.
2. An exercise of data types in PostGresql & Data Definition Language Commands
3. Exercise on Data Manipulation Language and Transaction Control Commands using PostgreSql.
4. Exercise on Types of Data Constraints using PostgreSql.
5. Exercise on JOINS (Single-Table) Using Normalization
6. Exercise on JOINS (Multiple-Table) Using Normalization
7. Exercise on GROUP BY/ORDER BY Clause and Date Arithmetic using PostgreSql.
8. Exercise on different Functions (Aggregate, Math and String)
9. Exercise on different types of sub queries
10. Procedures
11. View
12. Triggers

Intelligent System Design Lab			
Course Code:	**CS585**	**Credits:**	**2**
No. of Lectures (Hrs/Week):	**3**		
Total No. of Lectures:	**10**	**End Sem Exam Hours:**	**2**

1. Write a program for depth first search.
2. Write a program for best first search.
3. Write a program to generate the output for a* algorithm.
4. Write a lisp program to solve water jug problem using heuristic function.
5. Write a program to show the tic tac toe game for 0 and x.
6. Write a program for expert system by using forward chaining.
7. Write a program for expert system by using backward chaining.
8. Write a program for branch and bound searching technique.
9. Write a program for travelling-salesman problem.
10. Write a program for tower of hanoi problem.

SEMESTER II

ADVANCED SOFTWARE ENGINEERING			
Course Code:	**CS532**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I SOFTWARE ENGINEERING

Introduction to software engineering, Software Development Life Cycle, software process models, requirement analysis and design, software design process, coding, testing, implementation and maintenance, software metrics, agile software engineering, clean room software engineering, empirical software engineering.

UNIT II OBJECT-ORIENTED SOFTWARE ENGINEERING

OOSE, object-orientation paradigm, object-oriented programming languages, object modeling languages, object-oriented analysis, object-oriented design: design stereotypes and objects, design patterns; software design using patterns and framework, object-oriented case tools.

UNIT III COMPONENT-BASED SOFTWARE ENGINEERING

Component-Based Software Engineering (CBSE), CBSE and software reuse, CBSE vs. object-oriented software engineering, CBSE processes, domain engineering, component engineering, component-based software development life cycle, component vs. object, component-oriented programming, component-oriented programming vs. object-oriented programming, overview of component-based technology.

UNIT IV ASPECT-ORIENTED SOFTWARE ENGINEERING

Software engineering with aspects, aspects, aspect vs. object, aspect vs. component, join points and pointcuts, separation of concerns, crosscutting concerns, problems caused by scattering and tangling, system development, concepts of Aspect Oriented Programming, comparison to other programming paradigms.

UNIT V SOFTWARE RE-ENGINEERING AND REVERSE ENGINEERING

Re-engineering concept and approaches, redevelopment vs reengineering, reengineering process, reverse engineering, levels of reverse engineering: re-documentation, design recovery, specification recovery, conditions for reverse engineering, supporting techniques: forward engineering, restructuring, re-engineering, benefits of reverse engineering, software re-engineering patterns, patterns based software re-engineering, software re-engineering techniques.

Text Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing House, New Delhi 1997.
2. Ian Sommerville, Software Engineering, Pearson Education, 2009.

Reference Books:

3. Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc., 2004.
4. N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co (P) Ltd., New Delhi, 2002.
5. J. Rumbaugh, M. Blaha, W. Premerlani, Object-Oriented Modeling and Design, PHI, 1991.
6. George T. Heineman, William T. Councill, Component-Based Software Engineering: Putting the Pieces Together, Addision Wesley, 2001.
7. Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, Aspect-Oriented Software Development Addison-Wesley Professional, 2004.

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Advanced Data Structure & Algorithm Design			
Course Code:	**CS574**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION

Review of Basic Concepts: Abstract data types, Data structures, Algorithms, Big Oh, Small Oh, Omega and Theta notations, Solving recurrence equations, Master theorems, Generating function techniques, Constructive induction

UNIT II ADVANCE DATA STRUCTURE

Advanced Search Structures for Dictionary ADT: Splay trees, Amortized analysis, 2-3 trees, 2-3-4 trees, Red-black trees, Randomized structures, Skip lists, Treaps, Universal hash functions, Disjoint sets / union-find

UNIT III

Advanced Structures for Priority Queues and Their Extensions: Binomial heaps, Leftist heaps, skewed heaps, Fibonacci heaps and its amortized analysis, Applications to minimum spanning tree algorithms, Randomized algorithms, Approximation algorithms, NP-Completeness

UNIT IVALGORITHM TECHNIQUE

Divide and Conquer, Searching and Traversal techniques: General method, merge sort, quick sort, Efficient non recursive tree traversal algorithms, DFS, BFS of Graphs, AND/OR graphs, game tree, Bi-connected components, Backtracking

UNIT V SELECTED TOPIC

Greedy method and Dynamic programming : General method (Greedy), Minimum cost spanning trees, Job sequencing with deadlines, General method (Dynamic Programming), Optimal binary search trees, 0/1 knapsack problem, Travelling sales person problem.

REFERENCES:

1. Jeff Edmonds, "How to Think about Algorithms", Cambridge University Press, 2008

2. Thomsas H. Coremen et.al "Introduction to Algorithms" Third Edition, PHI, 2009

3. Parag Himanshu Dave " Design and Analysis of Algorithm" First Edition, Pearson Education, 2008

Advanced Data Structure & Algorithm Design lab			
Course Code:	**CS574**	**Credits:**	**2**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**15**	**End Sem Exam Hours:**	**3**

1. Implementation of graph search algorithms.
2. Implementation and application of network flow and linear programming problems.
3. Implementation of algorithms using the hill climbing and dynamic programming design techniques.
4. Implementation of recursive backtracking algorithms.
5. Implementation of randomized algorithms.
6. Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks.
7. Developing applications involving concurrency.
8. Implement and apply concurrent linked lists, stacks, and queues.

ADVANCED OPERATING SYSTEM			
Course Code:	**CS576**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT 1:
Introduction To Operating Systems, Types Of Operating Systems, Operating System Structures. Operating System Services, System Calls, Virtual Machines, Operating System Design And Implementation.

UNIT II
Process Management: Process Concepts, Operations On Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple -Processor Scheduling.Thread Scheduling. Process Synchronization & Deadlocks: The Critical Section Problem, Semaphores, And Classical Problems Of Synchronization, Critical Regions, Monitors, Deadlocks,-System Model, Deadlocks Characterization, Methods For Handling Deadlocks, Deadlock- Prevention, Avoidance, Detection,& Recovery from Deadlocks.

UNIT III
Memory Management & File System Implementation: Logical Versus Physical Address Space, Paging And Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing, File System Implementation -Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers

UNIT IV
Distributed Operating Systems: Distributed System Goals, Types Of Distributed Systems, Styles &Architecture Of Distributed Systems, Threads, Virtualization, Clients, Servers, Code Migration, and Communication in Distributed Systems.

UNIT V
Distributed Systems & Synchronization: Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning Of Nodes, Data-Centric Consistency Models, Client-Centric Consistency Models, Consistency Protocols. Fault Tolerance, Security: Introduction To Fault Tolerance, Process Resilience,, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, Recovery, Secure Channels, Access Control, Security Management. Case Study: Over View Of UNIX, LINUX, Windows NT , Android And IOS Operating systems

Text Books:

1) Silberschatz & Galvin, 'Operating System Concepts', Wiley.
2) "DISTRIBUTED SYSTEMS", Second edition, Andrew S.Tanenbaum, Maarten Van teen.

References:

1) William Stallings-"Operating Systems"- 5th Edition - PHI
2) Charles Crowley, 'Operating Systems: A Design-Oriented Approach', Tata Hill Co.,1998 edition.
3) Andrew S.Tanenbaum, 'Modern Operating Systems', 2nd edition, 1995, PHI.
4) Advanced Concepts in Operating systems.Distributed, Database and Multiprocessor operating systems, Mukesh singhal, Niranjan G.Shivaratri, Tata McGraw Hill Edition.
5) Dhamdhere, "Operating Systems - A concept based approach", 2nd Edition, TMH, 2006.
6) Daniel P Bovet and Marco Cesati, "Understanding the Linux Kernel ", 3rd Edition,' Reilly, 2005.
7) Pradeep K. Sinha, "Distributed Operating Systems - Concepts and Design", 2nd Edition, IEEE 1997.

ELECTIVES

CLOUD COMPUTING			
Course Code:	**CS 578**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT- I CLOUD ARCHITECTURE AND MODEL

Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models:- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

UNIT- II VIRTUALIZATION Basics of Virtualization

Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation.

UNIT -III CLOUD INFRASTRUCTURE

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

UNIT- IV PROGRAMMING MODEL

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

UNIT- V SECURITY IN THE CLOUD

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

ADVANCED DIGTAL COMMUNCIATION SYSTEM			
Course Code:	**EC531**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Pulse Modulation Analog Signals:- Sampling of Signal, Sampling Theorem for Low Pass and Band Pass Signals, Aliasing, Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM), Channel Bandwidth for PAM-TDM Signal, Types of Sampling, Instantaneous, Natural and Flat Top (Mathematical and Spectral Analysis), Aperture Effect, Introduction to Pulse Position and Pulse Duration Modulation.

Unit II: Pulse Code Modulation Digital Signal:- Quantization, Quantization Error, Pulse Code Modulation (PCM), Signal-to-Noise Ratio in PCM, Companding, Data Rate and Bandwidth of Multiplexed PCM Signal, Inter-symbol Interference, Eye Diagram, Line Coding NRZ, RZ, Biphase, Duo Binary Etc ,Differential PCM (DPCM), Delta Modulation (DM), and Adaptive Delta Modulation (ADM), Slope Overload Error ,Granular Noise ,Comparison of various system in terms of Bandwidth and Signal-to-Noise Ratio.

Unit III: Digital Modulation Techniques :- Analysis, Generation and Detection (Block Diagram), Spectrum and Bandwidth of Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset and Non-offset Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying (BFSK), M-ary FSK, Minimum Shift Keying, Quadrature Amplitude Modulation (QAM), Comparison of digital modulation techniques on the basis of probability of error, Matched Filter.

Unit IV: Concept of Probability, Relative Frequency and Probability Conditional Probability and Independent Events, Random Variables, Discrete Random Variables, Cumulative Distribution Function(CDF), Probability Density Function(PDF),Statistical Averages (Means),Chebyshev's Inequality, Central Limit Theorem.

Unit V: Spread Spectrum Modulation: Pseudo random noise sequences, notion of spread spectrum, direct sequence, frequency hopping, processing gain. Convolution codes and Golay codes.

Text Books:

[1] B. Sklar, Digital Communication, Pearson Education.
[2] Tomasi: Advanced Electronics Communication Systems, 6th Edition, PHI

References:

[1] Taub & Schilling, Principles of Communication system, TMH.
[2] Lathi B.P., Modern Analog and Digital Communication systems, Oxford Uni. Press.
[3] Haykin Simon, Digital Communication, Wiley Publication.
[4] Proakis, Digital communication, McGraw Hill
[5] Schaum's Outline series, Analog and Digital Communication.
[6] Singh and Sapre: Communication System, TMH
[7] Couch: Digital and Analog Communication, Pearson Education
[8] David Smith: Digital Transmission Systems, Springer- Macmillan India Ltd

AI and Neural Networks			
Course Code:	**CS586**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT-I – Biological Inspiration and Introduction

Biological neuron and its working; Mc-Culloch Pitts Neuron; Perceptron Model; Decision boundaries and limitation of perceptron model; Activation functions; Feedforward and feedback networks; Learning and adaptation – learning as approximation, supervised, unsupervised and reinforced learning; Neural network learning rules – Hebbian, Perceptron, delta, Widrow-Hoff, Correlation, Winner-takes-all, and outstar learning rules.

UNIT-II – Single Layer Perceptron Classifiers

Classification models – features and decision regions; Discriminant functions; Linear machine and minimum distance classification; non-parametric training concepts; training and classification using discrete perceptron; Single-Layer continuous perceptron networks for linearly separable classifications; Multicategory Single-layer Perceptron networks.

UNIT-III – Multilayer Feedforward Networks

Linearly non-separable pattern classification; Delta learning rule for MLP; Generalized Delta learning rule; Feedforward recall and error back propagation training; learning factors – initial weights; cumulative weight adjustment versus incremental update; steepness of activation function; learning constant; momentum method; necessary number of hidden neurons; Character recognition and control applications through MLP.

UNIT- IV- UNCERTAIN KNOWLEDGE AND REASONING

Uncertainty, review of probability, probabilistic Reasoning, Bayesian networks,inferences in Bayesian netwo rks, Temporal models ,Hidden Markov models

UNIT –V- LEARNING

Learning from observation, Inductive learning, Decision trees, Explanation based learning ,Statistical Learni ng methods , Reinforcement Learning.

Reference Books:

1. Neural Networks: A Comprehensive Foundation, Simon Haykin, Pearson Education.
2. Artificial Neural Networks, B. Yegnanarayna, PHI
3. Introduction to Neural Networks, Lawrence, Jeanette, California Scientific Software Press
4. Artificial Neural Networks, Robert Schalkoff, TMH
5. Introduction to the Math of Neural Networks, Jeff Heaton, Heaton Research, Inc.

ADVANCED INTERNET TECHNOLOGY			
Course Code:	**CS 588**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I

DNS, Working of DNS, DNS Header, Type of Records in DNS, forward and Reverse lookup, Configuration of Open Source (OS) DNS, working of DDNS - DHCP, DHCP header, Working of DHCP, Configuration of OS DHCP - FTP, Working of FTP, Configuration of OS Public FTP server and Private FTP server Understanding IPv6, CIDR, Hierarchical Routing, and Routing Protocol over internet. Multimedia over Internet, Voice over IP, Virtual Private network

UNIT II

Understanding Web Services technology, REST based web services (Resource Oriented Architecture) and Service oriented Architecture, Introduction to cloud computing, case study and working of Google App engine and Amazon cloud, Working of Peer to Peer over internet with case study of Bittorent .

UNIT III

HTML 5.0, Rich Internet Technology, AJAX, FLEX , Integrating PHP and AJAX, Consuming Web Service with AJAX, Resource Syndication (RSS), Working principle of search engines

UNIT IV

Public Key Infrastructure, Client side Vulnerabilities, Server Side Vulnerabilities, Database Vulnerabilities, Secure Payment Mechanism, Security issues in cloud

UNIT V

HTTP Authentication, Compare and Contrast, Application Types (BASIC, DIGEST, FORM and Client CERT), Retrieving Authentication Information, Security in Servelet , Form Based Custom, Authorisation, Retrieving SSL Authentication

References Books:

1. TCP/IP Protocol Suite : By Behrouz A. Forouzan : Tata McGraw-Hill Section
2. Cloud Computing : A practical Approach: By Anthony T. Velte : Tata McGraw-Hill
3. Using Google App Engine: By Charles : Oíreilly Press
4. Cloud Application Architecture: By George: Oíreilly Press
5. RESTful web services: By Leonard: OíReilly Press
6. Web Services Essentials:By Ethan: OíReilly Section
7. Rich Internet Application AJAX and Beyond: B y Dana moore : Wrox press
8. Web 2.0 Programming : By Eric : Wrox Press
9. HTML 5.0: By Mark: Oíreilly Press
10. Web Technologies NEW :Black Book : Dreamtech Section
11. Information Security :By Mark Stamp : Wiley Publication
12. Cloud Security and Privacy: By Tim : OíReilly

HIGH SPEED NETWORKS			
Course Code:	**CS 590**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit No.I:Layered Network Architectures

Review of Open Systems Interconnection (OSI) and Transmission Control Protocol/Internet Protocol, and Internetworking

Unit No. II: Point-To-Point Protocols and Links

Error detection – ARQ: Retransmission strategies – Framing – Point-to-point protocols at the network layer – The Transport layer – Broadband ISDN – Frame Relay – Asynchronous Transfer Mode.

Unit No. III:Delay Models In Data Networks

M/M/1, M/M/m, M/M/m/m, M/M/8, M/G/1 queuing models – Networks of Transmission lines - Time reversibility (Burke's theorem) – Network of Queues (Jackson's theorem).

Unit No. IV: Routing In Data Networks and Internet Routing

Wide area networking – Interconnected network Routing – Shortest path Routing – Multicast/Broadcast Routing information – Flow models – Optimal Routing and Topological design – Characterization of Optimal Routing – Interior and Exterior Routing protocols.

Unit No. V:Congestion, Traffic Management And Flow Control

Congestion control in data networks and Internets – Link-level flow and error control – TCP traffic control – Traffic and Congestion control in ATM networks – Means of Flow control – Main objectives of flow control – Window flow control – Rate control schemes.

Reference Books

1.Dimitri Bertsekas and Robert Gallager , "Data networks" ,Second Edition, Prentice Hall, Inc.,NJ, USA1992

2. William Stalling, "High Speed Networks and Internets", Second Edition, Pearson EducationInc., New Delhi, India, 2002

3. Leon Garcia and Widjaja ," Communication networks: Fundamental concepts and key architectures", McGraw Hill, Inc., NY, USA, 2006

SOFT COMPUTING TECHNIQUES			
Course Code:	**CS564**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I FUZZY LOGIC

Introduction to fuzzy logic, classical and fuzzy sets, overview of fuzzy sets, membership function, fuzzy rule generation, operations on fuzzy sets: compliment, intersection, union, combinations on operations, aggregation operation.

UNIT II FUZZY ARITHMETIC

Fuzzy numbers, linguistic variables, arithmetic operations on intervals & numbers, uncertainty based information, information and uncertainty, no specificity of fuzzy and crisp sets, fuzziness of fuzzy sets.

UNIT III NEURAL NETWORK

Overview of biological neurons, computational neuron, mathematical model of neurons, ANN architecture, single layer and multilayer architectures, activation function, threshold value, self learning and forced learning algorithms, feed forward and feedback architectures.

UNIT IV LEARNING FUNDAMENTALS

Learning paradigms, supervised and unsupervised learning, reinforced learning, ANN training, algorithms perceptions, training rules, delta, back propagation algorithm, multilayer perception model, Hopfield networks, associative memories, applications of artificial neural networks,

UNIT V GENETIC ALGORITHMS

History of genetic algorithm, terminology of genetic algorithm, biological background, creation of offspring, working principles of genetic algorithms, fitness function, reproduction: Roulette wheel selection, Boltzmann selection, cross over mutation, inversion, deletion, and duplication, generation cycle.

UNIT VI CONCEPT OF UNCERTAINTY

Presence of uncertainty in real world problems, handling uncertain knowledge, degree of belief, degree of disbelief, uncertainty and rational decisions, decision theory, utility theory, concept of independent events, Bay's rule, using Bay's rule for combining events.

Text Books:

1. Artificial Neural Networks: An introduction to ANN Theory and Practice, Peteus J. Braspenning, PHI publication, 2005.
2. Fuzzy Logic: A spectrum of Theoretical and Practical issues, Paul P. Wang, pearson publication 2004.

Reference Books:

3. Fuzzy Sets, Fuzzy logic, and Fuzzy Systems: Selected Papers- Lotfi Asker Zadeh, George J. Kilr, Bo yuan, 2005.
4. Foundations of Fuzzy logic and Soft Computing: 12th International Fuzzy conference proceeding, 2005.
5. Neural Networks Theory, Particia Melin, Oxford University press, 2003, Neural Networks Theory and Application, Oscar Castillo, Wiley Eastern publication

ADVANCED JAVA PROGRAMMING			
Course Code:	**CS 592**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I JAVA BASICS REVIEW

Java history, Java features, Java streaming, Java and Internet, Java contribution to Internet: Java applets, security, portability; Java environment, Java library, Java program structure, Java Virtual Machine (JVM) architecture, Just In Time compiler (JIT), data type, variables and arrays, operators, control statements, object-oriented paradigms: abstraction, encapsulation, inheritance, polymorphism; Java class and OOP implementation, packages and interfaces, multithreading.

UNIT II DISTRIBUTED COMPUTING

Collection framework, custom sockets, Remote Method Invocation (RMI), activation, object serialization, distributed garbage collection, RMI-IIOP (Internet Inter ORB (Object Request Broker) Protocol), interface definition language, JINI, Common Object Request Broker Architecture (CORBA), Java Data Base Connectivity (JDBC), Servlets.

UNIT III JAVA BEANS AND SWING

Bean concepts, bean writing process, bean to build application: packaging beans in Java Archive (JAR) file, composing beans in a builder environment; naming patterns for bean properties and events, bean property types, files events in bean box, bean customization, persistence, application, origin of swing, swing and Abstract Window Toolkit (AWT), deployment using swing, advanced swing techniques, JAR file handling, exploring swings, advanced swing.

UNIT IV JAVA ENTERPRISE APPLICATIONS

Java Native Interface (JNI) technology, Java Servlet, Java Server Pages (JSP), JDBC, session beans, entity beans, Enterprise Java Beans (EJB), programming and deploying EJB, Java transactions, Java 2 Enterprise Editions (J2EE), J2EE design pattern, J2EE architecture, J2EE components and containers, J2EE services, Unified Modeling Language (UML), Extensible Markup Language (XML).

UNIT V STRUTS, HIBERNATE AND SPRING

Struts 2 frameworks, working with struts 2 actions, adding workflow with interceptors, data transfer, struts tags, user interface tags, integration with spring and hibernate, exploring the validation framework, internationalization, hibernate, hibernate architecture, hibernate configuration, creating persistent classes, mapping inheritance with Java classes, working with collections, persistent objects, scalar queries and hibernate query language, hibernate caching, hibernate transactions and locking, hibernate and XDOCLET, hibernate and eclipse, spring, basic bean wiring, advanced bean wiring, spring and EJB, spring with JDBC.

Reference Books:

1. Core JAVA: Advance Features, Hortsmann, Cornell, Pearson Education, 2009.
2. Programming with JAVA, E. Balagurusawamy, Tata McGraw Hill, 1998.
3. JAVA Beginner's guide, Herbert Schildt, Tata McGraw Hill, 2007.
4. Java How to Program, Deitel & Deitel, Prentice-Hall, 1999.
5. The Complete Reference JAVA 2, Herbert Schildt, 7th Edition, Tata McGraw Hill, 2009.
6. The Complete Reference J2EE, James Keogh, Tata McGraw Hill, 2002
7. The Complete Reference Struts, James Holmes, Tata McGraw Hill, 2007.
8. Swings: A Beginners' Guide, Herbert Schildt, Tata McGraw Hill, 2006.
9. Hibernate: A Developer's Notebook, James Elliott, O'Reily Media Inc, 2004.
10. The JAVA Handbook, Patrick Naughton, Michael Morrison, Osborne/McGraw-Hill, 1996.
11. The Java Programming Language, Ken Arnold, James Gosling, Addison-Wesley, 1996.
12. Professional Java Development with the Spring Framework, Rod Johnson, Jorgen Hoeller, Alef Arendsen, Thomas Risberg, Colin Sampaleanu, Wrox, 2005.

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WIRELESS MOBILE NETWORKS			
Course Code:	**CS596**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT -I:

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

UNIT II:

Wireless propagation channels, propagation mechanisms (qualitative treatment), Propagation effects with mobile radio, Channel Classification, Link calculations, Narrowband and Wideband models.

UNIT –III:

Wireless Technology, wireless advantages and disadvantages, Wireless Data Transmission, understanding radio frequency communication. How antenna works.

UNIT –IV:

Low rate wireless personal area networks, high rate wireless personal area networks, low speed wireless LANs, High Speed wireless WLANs, Wireless MANs.

UNIT -V:

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access Control, Comparision of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCE BOOKS:

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – Upen Dalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.

EMBEDDED LINUX			
Course Code:	**CS 598**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT 1

Introduction: Embedded Linux, Real Time Linux,Types of Embedded Linux systems, Advantages of Linux OS, Using distributions, Examples of Embedded Linux systems- system architecture, Types of host/target architectures for the development of Embedded Linux Systems, Debug setups, Boot Configurations, Processor architectures supported by Linux

UNIT2

Cross platform Development Tool Chain: GNU tool chain basics, Kernel Headers Setup, Binutils setup, Bootstrap Compiler Setup, Library Setup, Full Compiler Setup, Using the tool chain, C library alternatives, JAVA, Perl, Python, Ada, IDEs , Terminal Emulators

UNIT3

Kernel and Root File System Kernel Considerations- selection, configuration , Compiling and Installing the kernel Root File System Structure, Librariries, Kernel Modules, Kernel Images, Device Files, Main System Applications, Custom Applications, System Initialization

UNIT4

Storage Device Manipulation: MTD-Supported Devices,Disk Devices, Swapping

Root FilesystemSetup: Filesystem Types for Embedded Devices, Writing a Filesystem Image to Flash using an NFS-Mounted Root Filesystem, Placing a Disk Filesystem on a RAM Disk, Rootfs and Initramfs, Choosing a Filesystem's Type and Layout, Handling Software Upgrades

Setting Up the Bootloader: Embedded Bootloaders, Server Setup for Network Boot, Using the U-Boot Bootloader

UNIT 5

Device Drivers: Introduction, Building and running modules, Char Drivers,Allocating memory, USB Drivers, Device Model, Memory mapping and DMA, Block Drivers, TTY Drivers

Text Books:

1. Building Embedded Linux Systems **,** Karim Yaghmour, JonJasonBrittain and Ian F. Darwin Masters, Gilad Ben-Yossef, and Philippe Gerum**,** O'Reilly

2. Linux Device Drivers, Alessandro Rubini, Jonathan Corbet, O'Reilly

Reference:

1. Embedded Linux Primer A Practical Real – World Approach, Christopher Hallinan, Prentice Hall

2. Embedded Linux System Design and Development, P Raghavan, Amol Lad, SriramNeelakandan, Auerbach Publications

3. Essential Linux Device Drivers, Alan Cox, Sreekrishnan,Venkateswaran, Pretice Hall

4. Embedded Linux Hardware, Software and Interfacing Craig Hollabaugh, Pearson Education

SEMESTER III

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Computer Security			
Course Code:	**CS 695**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT 1

Introduction: Information security, threats, vulnerabilities, controls; risk; Security requirements: confidentiality; integrity; availability; authentication; authorization; access control, security policies, security mechanisms; assurance; prevention, detection, deterrence, Physical security.

UNIT2.

Basic cryptography: Basic cryptographic terms, Symmetric and Asymmetric crypto methods, security attacks, Malicious code: viruses, Trojan horses, worms, Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation, Defenses; Software development controls; testing techniques.

UNIT 3.

Security in Operating Systems: Memory, time, file, object protection requirements and techniques, Protection in contemporary operating systems, Identification, and Authorization Identification and, Identification goals, Authentication requirements, Human authentication, Machine authentication, OS integrity checks, Anti-virus software

UNIT 4.

Trusted operating systems and Database management systems security: Assurance; trust, Design principles, Evaluation criteria, Evaluation process, Database management systems security basics; integrity and secrecy, Inference control, multilevel databases

UNIT 5.

Wireless and Network security: Introduction to network security issues and techniques: eavesdropping, spoofing, modification, denial of service attacks, firewalls and its types, virtual private networks, Intrusion detection and prevention, Security issues in wireless network.

Reference books:

1. Charles P. Pfleeger and Shari L. Pfleeger. Security in Computing (3rd edition). Prentice-Hall. 2003. ISBN: 0-13-035548-8.
2. Information Security Principles & Practices by Merkow
3. Information Security Fundamentals by Thomas R. Peltier, Justin Peltier, & John Blackley
4. Cryptography and Network Security Principles and Practices, Fourth Edition by William Stallings

ELECTIVES

ASPECT-ORIENTED SOFTWARE ENGINEERING			
Course Code:	**CS641**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I ASPECT-ORIENTED SOFTWARE ENGINEERING

Software engineering with aspects, aspect-oriented software evolution, aspects, aspect vs. object, aspect vs. component, join points and pointcuts, separation of concerns, crosscutting concerns, problems caused by scattering and tangling.

UNIT II ASPECT-ORIENTED PROGRAMMING

Concepts of AOP, inter-type declarations, implementation, comparison to other programming paradigms, nature of aspect-orientation, concepts and terminology, Join Point Model, AspectJ Point Model, pointcut designators, inter-type declarations, aspect weaving, comparison with object-oriented programming.

UNIT III ASPECT-ORIENTED REQUIREMENT ENGINEERING

Aspect-oriented requirements engineering and process, aspect-oriented requirements notations, aspect-oriented requirements tool support, adoption and integration of aspect-oriented requirements engineering, and assessment/evaluation of aspect-oriented requirements.

UNIT IV ASPECT-ORIENTED SOFTWARE ARCHITECTURE

Aspect-oriented software architecture and process, aspect-oriented architecture notations, aspect-oriented architecture tool support, adoption and integration of aspect-oriented architecture, and assessment/evaluation of aspect-oriented architecture.

UNIT V ASPECT-ORIENTED MODELING AND DESIGN

Aspect-Oriented Modeling, AOM approach, aspect model, aspect-oriented design, aspect-oriented design process, aspect-oriented design notations, aspect-oriented design tool support, aspect-oriented design, AspectJ, Aspect Werkz, Hyper/J, Java Aspect Component.

Reference Books:

1. Aspect-Oriented Software Development, Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, Addison-Wesley Professional, 2004.
2. Aspect-Oriented Software Development with Use Cases, Ivar Jacobson, Addison-Wesley Object Technology Series, 2005.
3. Aspect-Oriented Analysis and Design: The Theme Approach, Siobhán Clarke, Addison-Wesley Object Technology Series, 2005.

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Multimedia and Computer Graphics			
Course Code:	**CS675**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT-I

Introduction: The Advantages of Interactive Graphics, Representative Uses of Computer Graphics, Classification of Application Development of Hardware and software for computer Graphics, Conceptual Framework for Interactive Graphics, Overview, Scan: Converting Lines, Scan Converting Circles, Scan Converting Ellipses.

UNIT-II

Hardcopy Technologies, Display Technologies, Raster-Scan Display System, Video Controller, Random-Scan Display processor, Input Devices for Operator Interaction, Image Scanners, Working exposure on graphics tools like Dream Weaver, 3D Effects etc, Clipping Southland- Cohen Algorithm, Cyrus-Beck Algorithm, Midpoint Subdivision Algorithm

UNIT-III

Geometrical Transformation 2D Transformation, Homogeneous Coordinates and Matrix Representation of 2D Transformations, composition of 2D Transformations, the Window-to-Viewport Transformations, Introduction to 3D Transformations Matrix.

UNIT-IV

Representing Curves & Surfaces Polygon meshes parametric, Cubic Curves, Quadric Surface; Solid Modeling Representing Solids, Regularized Boolean Set Operation primitive Instancing Sweep Representations, Boundary Representations, Spatial Partitioning Representations, Constructive Solid Geometry Comparison of Representations.

UNIT-V Introductory Concepts: Multimedia Definition, CD-ROM and the multimedia highway, Computer Animation (Design, types of animation, using different functions) Uses of Multimedia, Introduction to making multimedia – The stage of Project, hardware & software requirements to make good multimedia skills and Training opportunities in Multimedia Motivation for Multimedia usage

Referential Books:

1. Foley, Van Dam, Feiner, Hughes, Computer Graphics Principles& practice,2000.
2. D.J. Gibbs & D.C. Tsichritzs: Multimedia programming Object Environment& Frame work , 2000
3. Ralf Skinmeiz and Klana Naharstedt, Multimedia: computing, Communication and Applications, pearson, 2001
4. D.Haran & Baker. Computer Graphics Prentice Hall of India,1986

Information Theory and Coding			
Course Code:	**CS677**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INFORMATION THEORY

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit,Review of probability theory , Entropy, Mutual information , Data compression, Huffman coding , Asymptotic equi-partition property.

UNIT II SOURCE CODING: TEXT, AUDIO AND SPEECH

Universal source coding • Channel capacity • Differential entropy • Block codes and Convolutional codes ,Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vo coder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

UNIT IV ERROR CONTROL CODING: BLOCK CODES

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder anddecoder - CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES

Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

REFERENCE BOOKS:

1. R Bose, “Information Theory, Coding and Crptography”, TMH 2007
2. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002
3. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
4. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

Fuzzy Set Theory			
Course Code:	**CS679**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT-I - Introduction to Fuzzy Sets

Overview of crisp sets; crispness, vagueness, fuzziness and uncertainty; Fuzzy-sets – basic types and basic concepts; α-cuts, strong α-cuts, Representation of fuzzy sets; extension of fuzzy sets.

UNIT-II - Fuzzy Set Operations and Fuzzy Arithmatic

Fuzzy Complement; Fuzzy interaction, t-norms; Fuzzy unions, t-conorms; Combination of operations; Aggregation operation; Fuzzy numbers; Linguistic variables; Arithmatic operations on intervals; Arithmatic Operations on Fuzzy numbers;

UNIT-III - Fuzzy Relations and Fuzzy Logic

Crisp vs Fuzy relations; Projections and Cylindrical extansions; binary fuzzy relations; Binary relations on a single set; Fuzzy equivalence relations; Fuzzy Compatibility Relations; Fuzzy ordering Relations; Fuzzy Morphisms. Multivalued logics; Fuzzy propositions; Fuzzy quantifiers; Linguistic Hedges.

UNIT-IV - Possibility Theory and Uncertainity-Based Information

Fuzzy measures; Evidence Theory; Possibility Theory; Fuzzy Sets and Possibility Theory; Possibility Theory vs probability Theory. Information and uncertainty; Nonspecificity of Crisp Sets; Nonspecificity of Fuzzy Sets; Fuzziness of Fuzzy sets.

UNIT-V - Fuzzy Systems and Applications

Membership Functions; Features of the Membership Functions; Fuzzification; Defuzzification to crisp sets; λ-cuts for Fuzzy Relations; Defuzzification to Scalars;Fuzzy inference systems; Mamdani's fuzzy models; Sugeno's fuzzy models; Tsukamoto's fuzzy models; other variants; Applications

Reference Books:

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications – George J. Klir and Bo Yuan; PHI
2. Fuzzy Set Theory and Its Applications – H.J. Zimmermann; Kluwer Academic Publishers
3. Fuzzy Logic with Engineering Applications – T. J. Ross; Wiley

Parallel Computing			
Course Code:	**CS 693**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit 1:

Parallel Programming Paradigms, Parallel Architecture, Open MP&PRAM Model of Computation Lecture, PRAM, Models of Parallel Computation, Complexity, Memory Consistency, Memory Consistency & Performance Issues, Parallel Program Design, Shared Memory & Message Passing, Algorithms, Merging and Sorting.

Unit 2:

Principles of parallel algorithm design, decomposition techniques, mapping & scheduling computation, templates, Programming shared-address space systems, Cilk Plus, OpenMP, P threads.

Unit3:

Parallel computer architectures, shared memory systems and cache coherence, distributed-memory systems, interconnection networks and routing, Programming scalable systems, message passing: MPI, global address space languages

Unit 4:

Analytical modeling of program performance, speedup, efficiency, scalability, cost optimality, iso-efficiency, Collective communication, Synchronization, Non-numerical algorithms, sorting, graphs, dynamic programming.

Unit 5:

Numerical algorithms, dense matrix algorithms, sparse matrix algorithms, Performance measurement and analysis of parallel programs, GPU Programming, Problem solving on clusters using Map Reduce

References: 1. M J Quinn, Parallel Programming in C with MPI and OpenMP.

2. Simon Marlow, Parallel and Concurrent Programming in Haskell: Techniques for Multicore and Multithreaded Programming, O'Reilly Media.

3. Ananth Grama, George Karypis,Vipin Kumar, and Anshul Gupta, Introduction to Parallel Computing

4. D.Kirk and W. Hwu, Programming Massively Parallel Processors.

MOBILE COMPUTING			
Course Code:	**EC635**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Mobile Computing Architecture
Introduction to Mobile Communications and Computing : novel applications, limitations, and architecture. GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services.

Unit II: Client Programming
Desktop vs. mobile, hardware overview, mobile phones, PDA, design constraints in applications for handheld devices.

Unit III: Programming For the Palm OS
History of palm OS, palm OS architecture, application development, communication in palm OS, multimedia, and enhancements in the current release. Wireless devices with symbian OS; Introduction to Symbian OS, Symbian OS architecture, application for Symbian, control and compounds controls, active objects, localization, security on the Symbian OS, different flavors of windows CE, windows CE architecture, windows CE development environment.

Unit IV: Wireless Application Protocol (WAP)
Overview of the WAP, component of the WAP standards, protocol architecture, and treatment of protocols of all layers, services supporting WAP client, WAP architecture design principle, Bluetooth,J2ME.

Unit V: Special Topics in Mobile Computing
Mobile agent & its application, mobile data management, security framework for mobile environment, m-commerce: emerging applications, different players in m-commerce, m-commerce life cycle, mobile financial services, mobile entertainment services, and proactive service management.

Text Books:
[1] Mobile Computing, Asoke. K Talukder and Roopa R. Yavagal, TMH, 2005
[2] Mobile Communication, Jachan Schiller, Adison-Wesley, 2nd edition, 2003.

References:

[1]Wireless Communication: T. S. Rappapost, Peasson Education, New Delhi, 2001
[2] Wireless Networks: Kareh Pallavan & P. Krishnamurthy, Peasson Education, New Delhi, 2nd edition, 2004.
[3] Mobile Commerce and Applications, Upkar Varshney, A tutorial at IEEE International Conference on Wireless Communications (WCNC), 1999.

Ad Hoc Networks			
Course Code:	**CS 596**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT-I:
Wireless LANS and PANS: Introduction, Fundamentals of WLANS, IEEE 802.11 Standard, HIPERLAN Standard, Bluetooth, Home RF. Wireless Internet: Wireless Internet, Mobile IP, TCP in Wireless Domain, WAP, Optimizing Web Over Wireless.

UNIT-II:
AD HOC Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks, AD Hoc Wireless Internet. MAC Protocols for Ad Hoc Wireless Networks: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT -III:
Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols. Transport Layer and Security Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks, Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks.

UNIT –IV:
Quality of Service: Introduction, Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions, QoS Frameworks for Ad Hoc Wireless Networks. Energy Management: Introduction, Need for Energy Management in Ad Hoc Wireless Networks, Classification of Ad Hoc Wireless Networks, Battery Management Schemes, Transmission Power Management Schemes, System Power Management Schemes.

UNIT –V:
Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:
1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – Jagannathan Sarangapani, CRC Press
REFERENCE BOOKS:

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh ,1 ed. Pearson Education.
2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

Analytical Models for Computing Systems			
Course Code:	**CS 680**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I

Need Computer Systems, Overview of Analytical Models, Introduction to Queueing, Probability Review, Generating Random Variables for Simulation, Sample Paths, Little's Law and other Operational Laws, Modification for Closed Systems.

UNIT II

Discrete-Time Markov Chains, Ergodicity Theory, Real World Examples,Google, Aloha,Transition to Continuous-Time Markov Chain, M/M/1 and PASTA.

UNIT III

Server Farms: M/M/k and M/M/k/k, Capacity Provisioning for Server Farms, Time Reversibility and Burke's Theorem, Networks of Queues and Jackson Product Form, Classed and Closed Networks of Queues.

UNIT IV

Case Study of Real-world Workloads, Phase-Type Distributions and Matrix-Alalytic Methods, Networks with Time-Sharing Servers, M/G/1 Queue and the Inspection Paradox, Task Assignment Policies for Server Farms.

UNIT V

Performance Metrics, Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies . Scheduling Non-Preemptive and Preemptive Size-Based Policies, Scheduling SRPT and Fairness.

REFERENCES:

1. MorHarchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press, 2013.
2. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", Wiley-Interscience, 1991.
3. LievenEeckhout, "Computer Architecture Performance Evaluation Methods", Morgan and Claypool Publishers, 2010.
4. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.

Image Processing and Pattern Recognition			
Course Code:	**CS 671**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit 1:

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, sampling and quantization, Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.

Unit 2:

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections, Encoder-Decoder model, Types of redundancies.

Unit 3:

Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

Unit 4:

Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

Unit 5:

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding,

Object Recognition, Patterns and Patterns classes, recognition based on decision, matching, classifiers, clustering, neural networks, matching shape , numbers, string matching

References:

1. Frank Y. Shih, Image Processing and Pattern Recognition: Fundamentals and Techniques.
2. Gonzalez, Woods, and Eddins, Digital Image Processing Using MATLAB.
3. Gonzalez, Woods, Digital Image Processing.