SCHEME OF TEACHING AND EXAMINATION FOR
M.TECH. COMPUTER SCIENCE and ENGINEERING

I Semester

Subject Code	Name of the Subject	Hours per Week			Duration of Exam in Hours	Marks for		Total Marks
		Lecture	Practical	Field Work/ Tutorials		I.A.	Exam	
10SCS11	Computer Networks	04	--	02	03	50	100	150
10SCS12	Advances in Operating Systems	04	02	--	03	50	100	150
10SCS13	Advances in Database Management Systems	04	02	--	03	50	100	150
10SCS14	Computer Systems Performance Analysis	04	--	02	03	50	100	150
10SCS15x	Elective – I	04	--	02	03	50	100	150
10SCS16	Seminar	--	--	03	--	50	--	50
Total		**20**	**04**	**09**	**15**	**300**	**500**	**800**

Elective – I

10SCS151 Advances in Digital Image Processing

10SCS152 Computer Graphics & Visualization

10SCS153 Advances in Digital Signal Processing

Note: The Internal Assessment marks of 50 for the core subjects with 2 hours of practical will have 30 marks for theory and 20 marks for practical work

M. Tech in Computer Science and Engineering

I SEMESTER

COMPUTER NETWORKS

Subject Code: 10SCS11 **I.A. Marks : 50**
Hours/Week : 04 **Exam Hours: 03**
Total Hours : 52 **Exam Marks: 100**

1. Review of Basic Concepts: Building a Network; Applications; Requirements; Network Architecture; Implementing Network software; Performance; Physically connecting hosts; Hardware building blocks.
2. Packet Switching: Switching and forwarding; Bridges and LAN Switches; Cell Switching; Implementation and Performance.
3. Internetworking: Simple internetworking (IP); Routing; Global Internet; Multicast; MPLS
4. End –to-End Protocols: Simple demultiplexer (UDP); Reliable byte stream (TCP); RPC; RTP.
5. Congestion Control and Resource Allocation: Issues in resource allocation; Queuing discipline; TCP Congestion Control; Congestion-Avoidance mechanisms; Quality of Service.
6. Applications: Traditional applications; Web services; Multimedia applications; Overlay Networks.

TEXT BOOKS:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.

REFERENCE BOOKS:

1. Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata McGraw Hill, 2006.
2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
3. Alberto Leon-Garcia and Indra Widjaja: Communication Networks -Fundamental Concepts and Key Architectures, 2nd Edition Tata McGraw-Hill, 2004.

Advances in Operating Systems

Subject Code : 10SCS12	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction, Review
Operating Systems Strategies: User' perspectives, technologies and examples of Batch Systems, Timesharing Systems, Personal computer systems, Embedded systems, and small communicating computers; The genesis of modern operating systems.
2. Using the Operating Systems
The programmer's abstract machine; Resources; Processes and threads; Writing concurrent programs.
3. Operating Systems Organization
Basic functions; General implementation considerations; Contemporary OS kernels.
4. Design Strategies
Design considerations; Monolithic kernels; Modular organization; Microkernel; Layered organizations; Operating Systems for distributed system.
5. Real World Examples
Linux, Windows NT/2000/XP: Process descriptors, Thread descriptors, Thread scheduling.
Linux, Windows NT/2000/XP: Kernel
6. Distributed Systems: Networking; The Need for a Protocol Architecture; The TCP/IP Sockets; Linux Networking; Client/Server Computing; Distributed Message Passing; Remote Procedure Calls; Clusters; Windows Vista Cluster Server; Linux Clusters; Distributed Process Management; Process Migration; Distributed Global States; Distributed Mutual Exclusion; Distributed Deadlock.

Laboratory Work:
(The following programs can be executed on any available and suitable platform)

1. Design, develop and execute a program using any thread library to create the number of threads specified by the user; each thread independently generates a random integer as an upper limit, and then computes and prints the number of primes less than or equal to that upper limit along with that upper limit.
2. Rewrite above program such that the processes instead of threads are created and the number of child processes created is fixed as two. The program should make use of kernel timer to measure and print the real time, processor time, user space time and kernel space time for each process.
3. Design, develop and implement a process with a producer thread and a consumer thread which make use of a bounded buffer (size can be prefixed at a suitable value) for communication. Use any suitable synchronization construct.
4. Design, develop, and execute a program to solve a system of n linear equations using Successive Over-relaxation method and n processes which use Shared Memory API.
5. Design, develop, and execute a program to demonstrate the use of RPC.

Text Books:

1. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2004.
2. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2008.

Reference Books:

1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006.
3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007.

Advances in Database Management Systems

Subject Code : 10SCS13	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. 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.
2. Object and Object-Relational Databases: Overview of Object-Oriented Concepts – Objects, Encapsulation, Type and class hierarchies, complex objects; Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; 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.
3. Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts.
4. Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.
5. Data Warehousing, Decision Support and Data Mining: Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support; View materialization; Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks.
6. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

Laboratory Work:
(The following tasks can be implemented on Oracle or any other suitable RDBMS with support for Object features)

1. Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects.
2. Develop a database application to demonstrate the representation of multivalued attributes, and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.
3. Design and develop a suitable Student Database application. One of the attributes to me maintained is the attendance of a student in each subject for which he/she has enrolled. Using TRIGGERS, write active rules to do the following:
    a. Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.
    b. Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.
4. Design, develop, and execute a program in a language of your choice to implement any one algorithm for mining association rules. Run the program against any large database available in the public domain and discuss the results.

TEXT BOOKS:
1. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.

REFERENCE BOOKS:
1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGraw Hill, 2010.
2. Connolly and Begg: Database Systems, 4th Edition, Pearson Publications, 2005.

Computer Systems Performance Analysis

Subject Code : 10SCS14	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction: The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.

2. Workloads, Workload Selection and Characterization: Types of Work loads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, Popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.

3. Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

4. Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote-Terminal Emulation; Components of an RTE; Limitations of RTEs.

5. Experimental Design and and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2^k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2^k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.

6. Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.

Text Book:

1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2007.

Reference Books:

1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, Elsevier, 2003.
2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India, 2001.

Advances in Digital Image Processing

Subject Code : 10SCS151	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. **Introduction:** Origins of Digital Image Processing, examples, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image analysis and computer vision, spatial feature extraction, transform features, Edge detection, gradient operators, compass operators, stochastic gradients, line and spot detection.
2. **Digital Image Fundamentals:** Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Zooming and Shrinking Digital Images, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

3. **Image Enhancement in the Spatial Domain:** Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.
4. **Image Enhancement in the Frequency Domain:** Background, Image Enhancement in the Frequency Domain, Introduction to the Fourier Transform and the Frequency, Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.
5. **Image Restoration:** A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations , Estimating the Degradation Function, Inverse Filtering ,Minimum Mean Square Error (Wiener) Filtering.
6. **Color Fundamentals:** Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images, Color Image Compression.
7. **Image Transformation:** Discrete Cosine Transforms, Walsh Hadmard Transforms, Wavelet Transforms and Multiprocessing, Background, Multiresolution Expansions, Wavelet Transforms in one Dimension, Wavelet Transforms in Two Dimensions, Wavelet Packets, an overview of Second Generation Wavelet Transforms.
8. **Image and Video Compression:** Fundamentals, Image Compression Models, Lossless compression Methods: Huffman coding, run length coding, LZ coding, Arithmetic coding, Lossy Compression: Gray level Run length coding, Block truncation coding, vector quantization, Differential predictive coding, Transform coding , Hybrid coding, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 .
9. **Morphological Image Processing:** Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms.
10. **Image Segmentation and Object Recognition:** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

TEXT BOOKS

1. Rafel C Gonzalez and Richard E. Woods: Digital Image Processing, PHI 2nd Edition 2005
2. Scott.E.Umbaugh: Computer Vision and Image Processing, Prentice Hall, 1997

REFERENCES:

1. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004.
2. Z. Li and M.S. Drew: Fundamentals of Multimedia, Pearson, 2004.
3. S.Jayaraman, S.Esakkirajan, T.Veerakumar: Digital Image Procesing, TataMcGraw Hill, 2004.

Computer Graphics and Visualization

Subject Code : 10SCS152	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable pipelines; Performance characteristics. Graphics Programming: The Sierpinski gasket; Programming two-dimensional applications.

2. The OpenGL: The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket; Plotting implicit functions.

3. Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; A simple CAD program; Building interactive models; Animating interactive programs; Design of interactive programs; Logic operations.

4. Geometric Objects and Transformations: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling. Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices; Interfaces to three-dimensional applications; Quaternions.

5. Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL; Hidden-surface removal; Interactive mesh displays; Parallel-projection matrices; Perspective-projection matrices; Projections and shadows.
6. Lighting and Shading: Light and matter; Light sources; The Phong lighting model; Computation of vectors; Polygonal shading; Approximation of a sphere by recursive subdivisions; Light sources in OpenGL; Specification of materials in OpenGL; Shading of the sphere model; Global illumination.
7. Curves and surfaces: Representation of curves and surfaces; Design criteria; Parametric cubic polynomial curves; Interpolation; Hermite curves and surfaces; Bezier curves and surfaces; Cubic B-Splines; General B-Splines; Rendering curves and surfaces; Curves and surfaces in OpenGL.

Text Book:

1. Edward Angel: Interactive Computer Graphics A Top-Down Approach with OpenGL, 5th Edition, Pearson, 2009.

Reference Books:

1. Donald Hearn and Pauline Baker: Computer Graphics- OpenGL Version, 2nd Edition, Pearson, 2004.
2. F.S. Hill,Jr.: "Computer Graphics Using OpenGL",2nd Edition, Pearson, 2001.
3. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, Computer Graphics, Addison-Wesley 1997.

Advances in Digital Signal Processing

Subject Code : 10SCS153	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction and Review: Basic concepts of Digital Signal Processing, Basic digital signal processing examples in block diagram, Overview of typical Digital Signal Processing in real-world applications.
2. Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digital-to-analog conversions.
3. Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design and implementation for sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band-pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing.
4. Linear Prediction and Optimum Linear Filters: Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction.
5. Power Spectrum Estimation: Estimation of spectra from finite-duration observations of signals, Non-parametric methods for power spectrum estimation, Parametric methods for Power Spectrum Estimation, Minimum variance spectral estimation, Eigenanalysis algorithm for spectral estimation.
6. Hardware and Software for Digital Signal Processors: Digital signal processor architecture, Digital signal processor hardware units, Fixed-point and floating-point formats.

TEXT BOOKS:

1. John G. Proakis and Dimitris G. Manolakis: Digital Signal Processing, 3rd Edition, Pearson, 2003.
2. Li Tan: Digital Signal Processing – Fundamentals and applications, Elsevier, 2008.

REFERENCE BOOKS:

1. Paulo S. R. Diniz, Eduardo A. B. da Silva And Sergio L. Netto: Digital Signal Processing: System Analysis and Design, Cambridge University Press, 2002.
2. Sanjit K. Mitra: Digital Signal Processing, A Computer Based Approach, Tata McGraw Hill, 2001.
3. Alan V.Oppenheim and Ronald W.Schafer: Digital Signal Processing, PHI Learning, 2003.

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II Semester

Subject Code	Name of the Subject	Hours per Week			Duration of Exam in Hours	Marks for		Total Marks
		Lecture	Practical	Field Work/ Tutorials		I.A.	Exam	
10SCS21	Formal Models in Computer Science	04	02	--	03	50	100	150
10SCS22	Advanced Algorithms	04	02	--	03	50	100	150
10SCS23	Advances in Computer Architecture	04	--	02	03	50	100	150
10SCS24	Optical Networks	04	--	02	03	50	100	150
10SCS25x	Elective – II	04	--	02	03	50	100	150
10SCS26	*Project Phase-I(6 Week Duration)	--	--		--			
10SCS27	Seminar			03		50	--	50
Total		**20**	**04**	**09**	**15**	**300**	**500**	**800**

Elective – II

10SCS251 Topics in Multimedia Communications

10SCS252 Topics in Artificial Intelligence

10SCS253 Protocols Engineering

***Between the II Semester and III Semester. After availing a vacation of 2 weeks.**

Note: The Internal Assessment marks of 50 for the core subjects with 2 hours of practical will have 30 marks for theory and 20 marks for practical work

Semester 2

Formal Models in Computer Science

Subject Code : 10SCS21 **IA Marks : 50**
No of Lecture Hrs/Week : 4 **Exam hours : 3**
Total No of Lecture Hours : 52 **Exam Marks : 100**

1. **Propositional Logic**
   Declarative sentences, Natural deduction, Propositional logic as a formal language, Semantics of propositional logic, Normal forms.
2. **Predicate Logic**
   The need for a richer language, Predicate logic as a formal language, Proof theory of predicate logic, Semantics of predicate logic, Undecidability of predicate logic, Micromodels of software.
3. **Verification by Model Checking**
   Motivation for verification, Linear-time temporal logic, Model checking, Branching-time logic, CTL* and the expressive powers of LTL and CTL.
4. **Program Verification**
   Need for specifying and verifying code, A framework for software verification, Proof calculus for partial correctness and total correctness, Programming by contract.
5. **Introduction to Z:** Basic concepts; Z notation in Propositional logic and Predicate logic.

Laboratory Work:

1. Design, develop and run a program in ALLOY (or in any equivalent system) to model a Software Package Dependency System. Make suitable assumptions regarding the system. The model should allow checking to see if prerequisites in the form of libraries or other packages are present for all components in the system
2. Design, develop and run a program in NuSMV (or in any equivalent system) to model and solve the Mutual Exclusion problem.

3. Design, develop and run a program in NuSMV (or in any equivalent system) to model and simulate the Alterate Bit Protocol.
4. Design, develop and run a program in NuSMV (or in any equivalent system) to model and solve the planning problem of Ferry Man.
5. Design, develop and run a program in NuSMV (or in any equivalent system) to model and solve the Dining Philosophers Problem.

Text Books::

1. Michael Huth and Mark Ryan: Logic in Computer Science, 2nd Edition, Cambridge University Press, 2004.
2. Jim Woodcock , Jim Davies: Using Z Specification, Refinement and Proof, Prentice Hall, 1996. (Online Edition: http://www.usingz.com/text/online/)

Advanced Algorithms

Subject Code : 10SCS22	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.
2. Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching.
3. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.
4. Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization.
5. String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.
6. Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Laboratory Work:

1. Design, develop, and run a program in any language to implement the Bellman-Ford algorithm and determine its performance.
2. Design, develop, and run a program in any language to implement Johnson's algorithm and determine its performance.
3. Design, develop, and run a program in any language to implement a Monte Carlo algorithm to test the primality of a given integer and determine its performance.
4. Design, develop, and run a program in any language to solve the string matching problem using naïve approach and the KMP algorithm and compare their performances.
5. Design, develop, and run a program in any language to solve modular linear equations.
6. Design, develop, and run a program in any language to implement the FFT algorithm efficiently.

TEXT BOOKS:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007.

Advances in Computer Architecture

Subject Code : 10SCS23	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction and Review of Fundamentals of Computer Design: Introduction; Classes computers; Defining computer architecture; Trends in Technology; Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance; Quantitative Principles of computer design; Performance and Price-Performance; Fallacies and pitfalls; Case studies.

2. Some topics in Pipelining, Instruction –Level Parallelism, Its Exploitation and Limits on ILP: Introduction to pipelining, ILP; Crosscutting issues, fallacies, and pitfalls with respect to pipelining; Basic concepts and challenges of ILP; Case study of Pentium 4, Fallacies and pitfalls. Introduction to limits in ILP; Performance and efficiency in advanced multiple-issue processors.

3. Memory Hierarchy Design, Storage Systems: Review of basic concepts; Crosscutting issues in the design of memory hierarchies; Case study of AMD Opteron memory hierarchy; Fallacies and pitfalls in the design of memory hierarchies. Introduction to Storage Systems; Advanced topics in disk storage; Definition and examples of real faults and failures; I/O performance, reliability measures, and benchmarks; Queuing theory; Crosscutting issues; Designing and evaluating an I/O system – The Internet archive cluster; Case study of NetAA FAS6000 filer; Fallacies and pitfalls.

4. Hardware and Software for VLIW and EPIC

Introduction: Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor, Concluding Remarks.

5. Large-Scale Multiprocessors and Scientific Applications

Introduction, Interprocessor Communication: The Critical Performance Issue, Characteristics of Scientific Applications, Synchronization: Scaling Up, Performance of Scientific Applications on Shared-Memory Multiprocessors, Performance Measurement of Parallel Processors with Scientific Applications, Implementing Cache Coherence, The Custom Cluster Approach: Blue Gene/L, Concluding Remarks.

6. Computer Arithmetic

Introduction, Basic Techniques of Integer Arithmetic, Floating Point, Floating-Point Multiplication, Floating-Point Addition, Division and Remainder, More on Floating-Point Arithmetic, Speeding Up Integer Addition, Speeding Up Integer Multiplication and Division, Fallacies and Pitfalls.

Text Book:

1. Hennessey and Patterson: "Computer Architecture A Quantitative Approach", 4th Edition, Elsevier, 2007.

Reference Books:

1. Kai Hwang: Advanced Computer Architecture - Parallelism, Scalability, Programmability, 2nd Edition, Tata McGraw Hill, 2010.

Optical Networks

Subject Code : 10SCS24	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. **Introduction:** Three generations of Digital Transport Networks; A brief introduction to WDM and TDM; The Optical Marketplace; Wireless Optical Systems; Key Optical Nodes; Other Key Terms; Evolution of Optical Systems; Key attributes of Optical Fiber.
2. **Telecommunications Infrastructure:** The Local Connections; The Backbone Connections; The Digital Multiplexing Hierarchy; The Digital Signaling Hierarchies; T1 / DS1 and T3/DS3; The Layered Protocol Model in the Transport Network; considerations for Interworking Layer1, Layer 2, and Layer 3 Networks.
3. **Characteristics of Optical Fiber:** The Basics; The Wavelength; The Basic Components; Structure of the Fiber; Fiber Types; Key Performance Properties of Fiber; Attenuation; Amplifier Spontaneous Emission; Chromatic Dispersion; Lasers.

4. **Timing and Synchronization:** Timing and Synchronization in Digital Networks; Effect of a Timing error; The Clocking Signal; Types of Timing in Networks; Timing Variations; Methods of Clock Exchange; Distribution of Timing Using SONET and DS1; Timing Downstream Devices; Building Integrated Timing Supply; Synchronization Status Messages and Timing Loops.
5. **SONET and SDH:** Introduction; The SONET Multiplexing Hierarchy; SONET and SDH Multiplexing Structure; The SONET / SDH Frame Structure; SONET and SDH Functional Components; SONET and SDH Problem Detection; Locating and Adjusting Payload with Pointers; Virtual Tributaries in more detail; Virtual Tributaries in Virtual Containers; The Overhead Bytes; SONET and SDH Concatenation.
6. **Architecture of Optical Transport Networks:** The Digital Wrapper; Control Planes; In-Band and Out-Band Control Signaling; Importance of Multiplexing and Multiplexing Hierarchies; Current Digital Transport Hierarchy; SONET Multiplexing Hierarchy; SDH Multiplexing Hierarchy; Key Indexes and Other Terms; The New Optical Transport and Digital Transport Hierarchy; The OTN Layered Model; Encapsulation and Decapsulation Operations; Generic Framing Procedure.
7. **WDM:** The WDM Operation; DWDM, TDM and WDM Topologies; Relationship of WDM to SONET / SDH; EDF; WDM Amplifiers; Add-Drop Multiplexers; WDM Cross-Connects; Wavelength Continuity Property; Examples of DWDM Wavelength Plan; Higher Dispersion for DWDM; Tunable DWDM Lasers.
8. **Network Topologies and Protection Schemes:** The Non-Negotiable Requirement Robust Networks; Diversity in the Network; Line and Path Protection Switching; Types of Topologies; Working and Protection Fibers; Point-to-Point Topology; BLSR; Protection Switching on Four-Fiber BLSR; Meshed Topologies; PONs; Ethernet in the Wide Area Backbone? Metro Optical Networking.
9. **MPLS and Optical Networks:** Label Switching; FEC; Types of MPLS Nodes; Label Distribution and Binding; Label Switching and Traffic Forwarding; MPLS Support of VPNs; MPLS Traffic Engineering; Multiprotocol Lambda Switching; MPLS and Optical TE Similarities; Possibilities for the MPIS Network; Control and Data Planes Interworking.
10. **Architecture of IP and MPLS-Based OTNs:** IP, MPLS, and Optical Control Planes; Interworking the three Control Planes; Management of the Planes; A Framework for the IP over Optical Networks; An Opposing View; Generalized MPLS use in Optical Networks; Bi-Directional LSPs in Optical Networks; GMPLS Extensions for G.709; GMPLS with SONET and SDH.
11. **The Link Management Protocol:** Keep the Optical Link up and running; What is managed? Data-bearing Links; Clarification of terms; Basic functions of LMP; Control Channel Management; Link Property Correlation; Fault Management; Extending LMP operations for Optical Link Systems.
12. **Optical Routers:** Optical Switching; Implementation Preferences; Key Terms; Evolution of Switching Networks; Optical Router; Optical Switching Technologies; Optical Resources; Protecting the Label Switched Paths; Protection of the OSP; Wavelength OSP and MPLS LSP; Nesting the LSPs and OSPs; Topologies for a Node Failure; Plane Coupling and De-Coupling; Some Endto-End Wavelengths and Node-to-Node Wavelengths; Granularity of Labels versus Wavelength Support; Approach to the Problem of LSP and OSP Interworking; MEMS and Optical Switching; Thermo-Optic Switches.
13. **ASON Operation at the UNI and NNI:** Objectives of ASON; UNI and NNI; Managing the Optical Bandwidth in the ASON; General approach to Optical Bandwidth Management; IETF Optical Carrier Framework for the UNI; Types of Connections; NNI; UNI and NNI Signaling Services.
14. **ATM versus IP in Optical Internets:** IP over ATM over SONET; The OSI and Internet Layered Models; ATM in the SONET / SDH Payload Envelope; PPP in the SONET Payload Envelope; Encapsulation / Framing Rules; The PPP Packet; The ATM versus IP; Overhead of IP and ATM; Three encapsulation methods.
15. **Evolving to 3G Architecture:** Migration of IP Optical Networking; IP and the Optical Backbones; Placing MPLS into the Picture; Putting it together.

TEXT BOOKS:

1. Uyless Black: Optical Networks, Pearson Education Asia, 2002.

REFERENCE BOOKS:

1. Rajiv Ramaswami and Kumar N.Sivaranjan: Optical Networks - A Practical Perspective, Morgan Kaufuann, 2000.
2. Paul E.Green Jr.,: Fiber Optic Network, Prentice Hall, 1993.
3. Jeff Hecht: Understanding Fiber Optics,4th Edition, PHI 1999.

Topics in Multimedia Communications

Subject Code : 10SCS251 **IA Marks : 50**

No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction to Multimedia Communications: Introduction, Human communication model, Evolution and convergence, Technology framework, Standardization framework.
2. Framework for Multimedia Standardization: Introduction, Standardization activities, Standards to build a new global information infrastructure, Standardization processes on multimedia communications, ITU-T mediacom2004 framework for multimedia, ISO/IEC MPEG-21 multimedia framework, IETF multimedia Internet standards.
3. Application Layer: Introduction, ITU applications, MPEG applications, Mobile servers and applications, Universal multimedia access.
4. Middleware Layer: Introduction to middleware for multimedia, Media coding, Media Streaming, Infrastructure for multimedia content distribution.
5. Network Layer: Introduction, QoS in Network Multimedia Systems.

TEXT BOOKS:
1. K.R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic: Introduction to Multimedia Communications – Applications, Middleware, Networking, Wiley India, 2006.

REFERENCE BOOKS:
1. Fred Halsall: Multimedia Communications – Applications, Networks, Protocols, and Standards, Pearson, 2001.
2. Nalin K Sharad: Multimedia information Networking, PHI, 2002.
3. Ralf Steinmetz, Klara Narstedt: Multimedia Fundamentals: Volume 1-Media Coding and Content Processing, 2nd Edition, Pearson, 2003.
4. Prabhat K. Andleigh, Kiran Thakrar: Multimedia Systems Design, PHI, 2003.

Topics in Artificial Intelligence

Subject Code : 10SCS252	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction and Review: What is AI? The foundations of AI, The history of AI.
2. Uncertainty: Acting under uncertainty; Inference using full joint distributions; Independence; Bayes' rule and its use; The Wumpus world revisted.
3. Probabilistic Reasoning: Representing knowledge in an uncertain domain; The semantics of Bayesian networks; Efficient representation of conditional distributions; Exact inference in Bayesian networks; Approximate inference in Bayesian Networks; Extending probability to first-order representations; Other approaches to Uncertain Reasoning.
4. Probabilistic Reasoning over Time: Time and uncertainty; Inference in temporal models; Hidden Markov models; Kalman filters; Dynamic Bayesian Networks; Speech recognition.
5. Learning from Observations: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory.
6. Knowledge in Learning: A logical formulation of learning; Knowledge in learning; Explanation-based learning; Learning using relevance information; Inductive logic programming.
7. Statistical Learning Methods: Statistical learning; Learning with complete data; Learning with hidden variables; Instance-based learning.
8. Reinforcement Learning: Introduction: Passive reinforcement learning; Active reinforcement learning; Generalization in reinforcement learning; Policy search.
9. Philosophical Foundations: Weak AI and Strong AI; The ethics and risks of developing AI.
10. AI: Present and Future: Agent components; Agent architectures; Are we going in the right direction? What if AI does succeed?

Text Book:
1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 2nd Edition, Pearson Education, 2003.

Reference Books:

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980.

PROTOCOLS ENGINEERING

Subject Code: 10SCS253	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Introduction: Communication model, Communication Software, Communication Subsystems, Communication Protocol Definition/Representation, Formal and Informal Protocol Development Methods, Protocol Engineering Phases

2. Error Control, Flow Control: Type of Transmission Errors, Linear Block Code, Cyclic Redundancy Checks, Introduction to Flow Control, Window Protocols, Sequence Numbers, Negative Acknowledgments, Congestion Avoidance

3. Network Reference Model: Layered Architecture, Network Services and Interfaces, Protocol Functions: Encapsulation, Segmentation, Reassembly, Multiplexing, Addressing, OSI Model Layer Functions, TCP/IP Protocol Suite, Application Protocols.

4. Protocol Specification: Components of specification, Service specification, Communication Service Specification Protocol entity specification: Sender, Receiver and Channel specification, Interface specifications, Interactions, Multimedia specifications, Alternating Bit Protocol Specification, RSVP specification.

5. Protocol Specification Language (SDL): Salient Features. Communication System Description using SDL, Structure of SDL. Data types and communication paths, Examples of SDL based Protocol Specifications: Question and answer protocol, X-on-X-off protocol, Alternating bit protocol, Sliding window protocol specification, TCP protocol specification, SDL based platform for network, OSPF, BGP Multi Protocol Label Switching SDL components.

6. Protocol Verification / Validation: Protocol Verification using FSM, ABP Verification, Protocol Design Errors, Deadlocks, Unspecified Reception, Non-executable Interactions, State Ambiguities, Protocol Validation Approaches: Perturbation Technique, Reachability Analysis, Fair Reachability Graphs, Process Algebra based Validation, SDL Based Protocol Verification: ABP Verification, Liveness Properties, SDL Based Protocol Validation: ABP Validation.

7. Protocol Conformance and Performance Testing: Conformance Testing Methodology and Framework, Local and Distributed Conformance Test Architectures, Test Sequence Generation Methods: T, U, D and W methods, Distributed Architecture by Local Methods, Synchronizable Test Sequence, Conformance testing with Tree and Tabular Combined Notation (TTCN), Conformance Testing of RIP, Testing Multimedia Systems, quality of service test architecture(QOS), Performance Test methods, SDL Based Performance Testing of TCP, OSPF, Interoperability testing, Scalability testing protocol synthesis problem

8. Protocol Synthesis and Implementation: Synthesis methods, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis, Requirements of Protocol Implementation, Objects Based Approach To Protocol Implementation, Protocol Compilers, Code generation from Estelle, LOTOS, SDL and CVOPS.

TEXT BOOKS:

1. Pallapa Venkataram and Sunilkumar S. Manvi: Communication Protocol Engineering, PHI, 2004.

REFERENCE BOOKS:

1. Mohammed G. Gouda: Elements of Protocol Design, Wiley Student Edition, 2004.

SCHEME OF TEACHING AND EXAMINATION FOR
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III Semester

Subject Code	Name of the Subject	Hours per Week			Duration of Exam in Hours	Marks for		Total Marks
		Lecture	Practical	Field Work/ Tutorials		I.A.	Exam	
10SCS31	Advances in VLSI Design and Algorithms	04	--		03	50	100	150
10SCS32x	Elective – III	04	--		03	50	100	150
10SCS33x	Elective – IV	04	--		03	50	100	150
10SCS34	Project Phase - II	--	--					--
10SCS35	Evaluation of Project Phase-I	--	--	03		50	--	50
Total		**12**		**03**	**09**	**200**	**300**	**500**

Elective – III		**Elective – IV**	
10SCS321	Wireless and Cellular Networks	10SCS331	Analysis of Computer Networks
10SCS322	Advances in Storage Area Networks	10SCS332	Advances in Compiler Design
10SCS323	Advances in Pattern Classification	10SCS333	Information Security

Note:3 Days Course work and 3 Days for Project Work

Semester 3

Advances in VLSI Design and Algorithms

Subject Code : 10SCS31 **IA Marks : 50**
No of Lecture Hrs/Week : 4 **Exam hours : 3**
Total No of Lecture Hours : 52 **Exam Marks : 100**

1. Introduction to Digital systems and VLSI: Why Design Integrated Circuits? Integrated Circuits manufacturing;
Integrated Circuit Design Techniques; IP-Based Design.
2. Fabrication and Devices: Introduction; Fabrication processes; Fabrication theory and practice; Reliability.
3. Sequential Machines: Introduction; Latches and Flip-flops; Sequential systems and clocking disciplines; Performance analysis; Clock generators; Sequential systems design, Power optimization, Design validation, Sequential testing.
4. Subsystem Design: Introduction; Combinational shifters; Adders; ALUs; Multipliers; High-density memory; Image sensors; FPGAs; PLA; Buses and networks on chips; Data paths; Subsystems as IP.
5. Architecture Design: Introduction; Hardware description languages; Register Transfer design; Pipelining; High-level synthesis; Architecture for low power; GALS systems; Architecture testing; IP components; Design methodologies; Multiprocessor system-on-Chip design.
6. Simulations: General remarks; Gate-level modeling and simulations; Switch-level modeling and simulation.

TEXT BOOKS:
1. Wayne Wolf: "**Modern VLSI design"**, 3rd edition, Pearson Education, 2007.
2. Sabih H Gerez: "**Algorithms for VLSI Design Automation"**, Wiley India, 2007,

Wireless and Cellular Networks

Subject Code : 10SCS321 **IA Marks : 50**
No of Lecture Hrs/Week : 4 **Exam hours : 3**
Total No of Lecture Hours : 52 **Exam Marks : 100**

1. Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications Mobil Radio Systems around the world examples of Wireless Communication Systems, Paging System, Cordless Telephone System. Cellular Telephone Systems, Comparison of Common Wireless Communications Systems.
2. Modern Wireless Communications Systems: Second generation (2G), Cellular Networks, evolution of 2.5G, TDMA Standards, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANS)
3. 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.
4. Mobile Radio Propagation: Introduction to radio wave propagation, Free space propagation model, Relating power to electric field, Reflection, Diffraction, Scattering.
5. Modulation Techniques for Mobile Radio: Frequency modulation Vs amplitude modulation, Amplitude modulation, Angle modulation, Digital Modulation, Linear Modulation techniques – Binary phases shift keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), Constant envelope modulation – Binary Frequency Shift Keying, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK).
6. Multiple Access Techniques for Wireless Communications: Introduction to Multiple access, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio. Protocols, Reservation Protocols – Reservation ALOHA, Packet Reservation Multiple Access (PRMA), Capacity of cellular systems.
7. Wireless Networking: Introduction, Difference between Wireless and Fixed Telephone Networks, Development of Wireless Networks, First generation, second generation, third generation.

TEXT BOOKS:
1. Theodore S Rappaport**:** Wireless Communications, Principles and Practice, 2nd Edition, Pearson Education Asia, 2002.

REFERENCE BOOKS:
1. William C Y Lee: Mobile Communications Engineering Theory and Applications, 2nd Edition, McGraw Hill, 1998.
2. William Stallings: Wireless Communications and Networks, Pearson Education Asia, 2002.

Advances in Storage Area Networks

Subject Code : 10SCS322	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access.
2. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.
3. I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre
Channel Protocol Stack; Fibre Channel SAN; IP Storage.
4. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Sotfware Architecture, Network connectivity, NAS as a storage system.
5. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.
6. Storage Virtualization: Definition of Storage virtualization ; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.
7. SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective.
8. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

9. Management: Planning Business Continuity; Managing availability; Managing Serviceability; Capacity planning; Security considerations.

Text Book:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2007.

Reference Books:

1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2003.
3. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A CompleteGuide to understanding and Implementing SANs", Wiley India, 2006.

Advances in Pattern Classification

Subject Code : 10SCS323	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction: Polynomial Curve Fitting, Probability Theory, Probability Distributions, Model Selection, Decision Theory, Information Theory
2. Linear Models for Regression: Linear Basis Function Models, The Bias Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison, The Evidence Approximation, Limitations of Fixed Basis Functions
3. Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, The Laplace Approximation, Bayesian Logistic Regression
4. Kernel Methods: Dual Representations, Constructing Kernels, RBF Networks, Gaussian Processes, Sparse Kernel Machines: SVMs, Multiclass SVMs, Relevance Vector Machines
5. Unsupervised Learning: Introduction, Association Rules, Cluster Analysis, Self-Organizing Maps, Principal Components, Curves and Surfaces, Non-negative Matrix Factorization, Independent Component Analysis and Exploratory Projection Pursuit, Multidimensional Scaling, Nonlinear Dimension Reduction and Local Multidimensional Scaling, The Google PageRank Algorithm
6. Mixture Models and EM: Mixtures of Gaussians, An alternative view of EM, The EM Algorithm in general.
7. High-Dimensional Problems: The Curse of Dimensionality, Diagonal Linear Discriminant Analysis and Nearest Shrunken Centroids, Linear Classifiers with Quadratic Regularization, Linear Classifiers with L1 Regularization, Classification when Features are Unavailable, High-Dimensional Regression: Supervised Principal Components, Feature Assessment and the Multiple-Testing Problem.

Text Books:

1. Christopher M Bishop: Pattern Recognition and Machine Learning, Springer, 2006.

2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman: The Elements of Statistical Learning, Springer, 2008.

Reference Books:

1. R. O. Duda, P. E. Hart, and D. G. Stork: Pattern Classification by 2nd edition, Wiley –Interscience, 2001.
2. Sergios Theodoridis and Konstantinos Koutroumbas: Pattern Recognition, 2nd Edition, Elsevier, 2003.

Analysis of Computer Networks

Subject Code : 10SCS331	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction: Two examples of analysis: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; The importance of quantitative modeling in the Engineering of Telecommunication Networks.
2. Multiplexing: Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.
3. Stream Sessions: Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling (continued).
3. Stream Sessions: Stochastic Analysis: Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little's theorem, Brumelle's theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range-Dependent traffic.
4. Adaptive Bandwidth Sharing for Elastic Traffic: Elastic transfers in a Network; Network parameters and performance objectives; Sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet's Adaptive Window Protocol; Bandwidth sharing in a Network.

TEXT BOOKS:
1. Anurag Kumar, D. Manjunath, Joy Kuri: Communication Networking An Analytical Approach, Elsevier, 2004.

REFERENCE BOOKS:
1. M. Schwartz**:** Broadband Integrated Networks, Prentice Hall PTR, 1996.
2. J. Walrand, P. Varaiya: High Performance Communication Networks, 2nd Edition, Morgan Kaufmann, 1999.

Advances in Compiler Design

Subject Code : 10SCS332	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction and Review: Language processors; The structure of a Compiler; The evolution of programming languages; The science of building a compiler; Applications of Compiler technology; Programming language basics.
2. Topics in Code Generation: Issues in the design of Code Generator; Peephole optimization; Register allocation and assignment; Instruction selection by tree rewriting; Optimal code generation for expressions; Dynamic programming code generation.
3. Machine-Independent Optimizations: The principle sources of optimization; Introduction to data flow analysis; Foundations of data flow analysis; Constant propagation; Partial-redundancy elimination; Loops in flow graphs; Region-based analysis; Symbolic analysis.
4. Instruction-Level Parallelism: Process architectures; Code-scheduling constraints; Basic-block scheduling; Global code scheduling; Software pipelining.
5. Optimizing for Parallelism and Locality: Basic concepts; An example of matrix multiplication; Iteration spaces; Affine array indexes; Data reuse; Array data – dependence analysis; Finding synchronization-free parallelism; Synchronization between parallel loops; Pipelining; Locality optimizations.

TEXT BOOKS:
1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman: Compilers - Principles, Techniques and Tools, 2nd Edition, Pearson, 2007.

REFERENCE BOOKS:
1. Charles N. Fischer, Richard J. leBlanc, Jr.: Crafting a Compiler with C, Pearson, 1991.
2. Andrew W Apple: Modern Compiler Implementation in C, Cambridge University Press, 1997.
3. Kenneth C Louden: Compiler Construction Principles & Practice, Cengage Learning, 1997.

Information Security

Subject Code : 10SCS333	**IA Marks : 50**
No of Lecture Hrs/Week : 4	**Exam hours : 3**
Total No of Lecture Hours : 52	**Exam Marks : 100**

1. Introduction to Information Security: Introduction; What is security? Critical characteristics of information; NSTISSC security model; Approaches to information security implementation; The Security System Development Life Cycle; Information Security Terminology.
2. Planning for Security: Introduction; Information Security Policy, Standards, and Practices; The Information Security Blue Print.
3. Security Technology: Firewalls and VPNs: Introduction, Physical design, Firewalls, Protecting Remote Connections. Intrusion Detection, Access control and Other Security Tools: Introduction; Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools; Access Control Devices.
4. Information Security maintenance: Introduction; Security Management Models; The Maintenance Model.
5. Introduction to Network Security: Attacks, Services, and Mechanisms; Security Attacks; Security Services; A model for Internetwork Security; Internet Standards and RFCs; Wireless network security.
6. Cryptography: Conventional Encryption Principles and Algorithms; Cipher Block Modes of Operation; Location of encryption devices; Key distribution; Approaches to message authentication; Secure Hash functions and HMAC; Public Key Cryptography Principles and Algorithms; Digital Signatures; Key management.
7. Authentication Applications: Kerberos, X.509 Directory Authentication Service.
8. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.
9. IP Security: IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management.
10. Web Security: Web security requirements, Secure Socket layer (SSL) and Transport layer Security (TLS), Secure Electronic Transaction (SET).
11. Software: Introduction; Software flaws; Malware; Software-based attacks; Digital Rights Management;

TEXT BOOKS:
1. Michael E. Whitman and Herbert J. Mattord: Principles of Information Security, 2nd Edition, Cengage Learning, 2005.
2. William Stallings: Network Security Essentials Applications and Standards, Person, 2000.
3. Deven N. Shah: Information Security – Principles and Practice, Wiley India, 2009.

REFERENCE BOOKS:
1. Behrouz A. Forouzan: Cryptography and Network Security, Tata McGraw-Hill, 2007.

SCHEME OF TEACHING AND EXAMINATION FOR
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IV Semester

Course Code	Subject	No. of Hrs./Week		Duration of the Exam in Hours	Marks for		Total Marks
		Lecture	Practical / Field Work		I.A.	Exam	
10SCS41	Evaluation of Project Phase - II	--	03		50	--	50
10SCS42	Evaluation of Project Phase - III	--	03		50	--	50
10SCS43	Project work Evaluation and Viva-voce	--	--	03	--	100+100	200
	Total	--	**06**	**03**	**100**	**200**	**300**
Grand Total (I to IV Semester) : 2400							

Note: Project work shall be continuously evaluated for Phase I, Phase II and after completion of the Project.