SCHEME OF TEACHING AND EXAMINATION FOR
M.TECH. COMPUTER NETWORK ENGINEERING

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	
10SCN11	Advanced Digital Communication	04	--	02	03	50	100	150
10SCN12	Computer Networks	04	02	--	03	50	100	150
10SCN13	Network Programming	04	02	--	03	50	100	150
10SCN14	Information Security	04	--	02	03	50	100	150
10SCN15x	Elective – I	04	--	02	03	50	100	150
10SCN16	Seminar	--	--	03	--	50	--	50
Total		**20**	**04**	**09**	**15**	**300**	**500**	**800**

I Semester

Elective – I

10SCN151 C# and .Net

10SCN152 Stochastic Models and Applications

10SCN153 System Modeling and Simulation

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

I SEMESTER

ADVANCED DIGITAL COMMUNICATION

Subject Code: 10SCN11 **I.A. Marks : 50**
Hours/Week : 04 **Exam Hours: 03**
Total Hours : 52 **Exam Marks: 100**

1. Digital Transmission Fundamentals: Digital Representation of Information: Block-Oriented Information, Stream Information; Why Digital Communications? Comparison of Analog and Digital Transmission , Basic properties of Digital Transmission Systems; Digital Representation of Analog Signals: Bandwidth of Analog Signals, Sampling of an Analog Signal, Digital Transmission of Analog Signals; Characterization of Communication Channels: Frequency Domain Characterization, Time Domain Characterization; Fundamental Limits in Digital Transmission: The Nyquist Signaling Rate, The Shannon Channel Capacity; Line Coding ; Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Telephone Modem Standards; Properties of Media and Digital Transmission Systems: Twisted Pair, Coaxial Cable, Optical Fiber, Radio Transmission, Infrared Light; Error
Detection and Correction: Error Detection, Two Dimensional Parity Checks, Internet Checksum, Polynomial Codes, Standardized Polynomial Codes, Error Detecting Capability of a Polynomial Code.

2. Brief Review of digital communication systems: Elements of Digital communication systems; Communication channels and their characteristics; Historical perspective in the development of digital communication; Review of the features of a decreases memory less channel and the channel capacity theorem

3. Wave form Coding Techniques: PCM, Channel. Noise and error probability, DPCM, DM, coding speech at low bit rates, Applications.

4. Base band Shaping for data transmission: Discrete PAM signals, Inter-symbol interference (ISI) Nyquist criterion for distortion-less Base band binary transmission, correlative coding, Eypattern, transmission, correlative coding, Eypatterns Based and M-ary PAM system, Adoptive Equalization, The zero forcing algorithm, The LMA algorithm

TEXT BOOKS:

1. Alberto Leon – Garcia and Indra Widjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition, Tata McGrawHill, 2006.
2. Simon Haykin: Digital Communication, Wiley India, 2007.

REFERENCE BOOKS:

1. John G Proakis: Digital Communications, 3rd Edition, McGraw Hill, 2008.
2. Leon W Couch: Analog / Digital Communication, 5th Edition, PHI, 2008.

COMPUTER NETWORKS

Subject Code: 10SCN12	**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.

Laboratory Work:

Using any Protocol Analyzer like Ethereal, perform the following experiments:
1. Capture the packets that are transmitted after clicking on the URL of the web site of your college. Analyze the packets at the highest level and prepare a brief report of your analysis.
2. Analyze the data captured above at lower levels and demonstrate the layering of the protocols.
3. Capture the ARP packets and find the MAC addresses in the LAN in your laboratory.

Using either NS228/OPNET or any other suitable simulator, perform the following experiments:
1. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
2. Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.

Implement the following in C/C++:
1. Write a program for distance vector algorithm to find suitable path for transmission.
2. Write a program for congestion control using leaky bucket algorithm.

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.

NETWORK PROGRAMMING

Subject Code: 10SCN13	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Review of Basic Concepts: Layering, OSI model, Processes, A simplified model, Client-Server model, A history of Unix Networking; Review of TCP/IP.
2. Sockets: Introduction, Unix domain protocols, socket addresses, elementary socket system calls, advanced socket system calls, reserved ports, stream pipes, passing file descriptions, socket options, asynchronous I/O, Input/Output Multiplexing, Out-of-Band data, sockets and signals, Internet superservers, socket implementation.
3. TFTP Protocol: Introduction, protocol, security, data formats, connections, client user interface, UDP implementation, TCP implementation.
4. Remote Command Execution: Introduction, Security issues, rcmd function and rshd server, rexec function and rexecd server.
5. Remote Login: Introduction, Terminal line disciplines, pseudo terminal, terminal modes, control terminals rlogin overview, rlogin client, rlogin server.
6. JAVA Network Programming: Introduction, Client-Server Computing, The InetAddress class, Serving multiple clients, Applet clients, Sending and receiving objects, Retrieving objects from Web servers, Datagram sockets.

TEXT BOOKS:

1. W. Richard Stevens: Unix Network Programming, PHI, 2001.
2. Y. Daniel Liang: Introduction to JAVA Programming, 6th Edition, Pearson, 2007.

REFERENCE BOOKS:

1. W. Richard Stevens: TCP/IP Illustrated, Volumes 1, 2, and 3, Pearson, 2000.

Laboratory Work:

1. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple echo server and demonstrate its working. Both the server and client are to be connection-oriented and use TCP. The system works as follows: Client reads a line from the standard input and writes the line to the server; the server reads a line from its network input and echoes the line back to the client; the client reads the echoed line and prints it on its standard output.
2. Repeat the above experiment using UDP instead of TCP.
3. Repeat the Experiment 1 using JAVA network programming facilities.
4. Modify the above program such that the client sends an integer value supposed to represent the radius of a circle and the server is to compute and return the corresponding area.
5. Extend the above program such that the server responds to multiple clients.

Mini Project: Design, develop, and execute a program in C under UNIX / LINUX environment to implement any utility in TCP?IP suite like PING, TFTP etc.

Information Security

Subject Code : 10SCN14	**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.

C# and .Net

Subject Code: 10SCN151	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. The Philosophy of .NET: Understanding the Previous State of Affairs, The .NET Solution, The Building Block of the .NET Platform (CLR,CTS, and CLS), The Role of the.NET Base Class Libraries, What C# Brings to the Table, An Overview of.NET Binaries (aka Assemblies), the Role of the Common Intermediate Language , The Role of .NET Type Metadata, The Role of the Assembly Manifest, Compiling CIL to Platform –Specific Instructions, Understanding the Common Type System, Intrinsic CTS Data Types, Understanding the Common Languages Specification, Understanding the Common Language Runtime A tour of the.NET Namespaces, Increasing Your Namespace Nomenclature, Deploying the .NET Runtime.
2. Building C# Applications: The Role of the Command Line Complier (csc.exe), Building C # Application using csc.exe Working with csc.exe Response Files, Generating Bug Reports , Remaining C# Compiler Options, The Command Line Debugger (cordbg.exe) Using the, Visual Studio .NET IDE, Other Key Aspects of the VS.NET IDE, C# "Preprocessor:" Directives, An Interesting Aside: The System. Environment Class
3. C# Language Fundamentals: The Anatomy of a Basic C# Class, Creating objects: Constructor Basics, The Composition of a C# Application, Default Assignment and Variable Scope, The C# Member Initialization Syntax, Basic Input and Output with the Console Class, Understanding Value Types and Reference Types, The Master Node: System, Object, The System Data Types (and C# Aliases),Converting Between Value Types and Reference Types: Boxing and Unboxing, Defining Program Constants, C# Iteration Constructs, C# Controls Flow Constructs, The Complete Set of C# Operators, Defining Custom Class Methods, Understating Static Methods, Methods Parameter Modifies, Array Manipulation in C #, String Manipulation in C#, C# Enumerations, Defining Structures in C#, Defining Custom Namespaces.
4. Object- Oriented Programming with C#: Forms defining of the C# Class, Definition the "Default Public Interface" of a Type, Recapping the Pillars of OOP, The First Pillars: C#'s Encapsulation Services, Pseudo-Encapsulation: Creating Read-Only Fields, The Second Pillar: C#'s Inheritance Supports, keeping Family Secrets: The "Protected" Keyword, Nested Type Definitions, The Third Pillar: C #'s Polymorphic Support, Casting Between
5. Exceptions and Object Lifetime: Ode to Errors, Bugs, and Exceptions, The Role of .NET Exception Handing, the System, Exception Base Class, Throwing a Generic Exception, Catching Exception, CLR System – Level Exception (System. System Exception), Custom Application-Level Exception (System. System Exception), Handling Multiple Exception, the Family Block, the Last Chance Exception. Dynamically Identifying Application and System Level Exception Debugging System Exception Using VS.NET, Understanding Object Lifetime, the CIT of "new', The Basics of Garbage Collection,, Finalization a Type, The Finalization Process, Building an Ad Hoc Destruction Method, Garbage Collection Optimizations, The System. GC Type.

6. Interfaces and Collections: Defining Interfaces Using C# Invoking Interface Members at the object Level, Exercising the Shapes Hierarchy, Understanding Explicit Interface Implementation, Interfaces As Polymorphic Agents, Building Interface Hierarchies, Implementing, Implementation, Interfaces Using VS .NET, understanding the IConvertible Interface, Building a Custom Enumerator(IEnumerable and Enumerator), Building Cloneable objects (ICloneable), Building Comparable Objects (IComparable), Exploring the system.Collections Namespace, Building a Custom Container (Retrofitting the Cars Type). Callback Interfaces, Delegates, and Events, Advanced Techniques Understanding Callback Interfaces, Understanding the .NET Delegate Type, Members of System. Multicast Delegate, The Simplest Possible Delegate Example, Building More a Elaborate Delegate Example, Understanding Asynchronous Delegates, Understanding (and Using)Events. The Advances Keywords of C#, A Catalog of C# Keywords Building a Custom Indexer, A Variation of the Cars Indexer Internal Representation of Type Indexer. Using C# Indexer from VB.NET. Overloading operators, The Internal Representation of Overloading Operators, interacting with Overload Operator from Overloaded- Operator- Challenged Languages, Creating Custom
Conversion Routines, Defining Implicit Conversion Routines, The Internal\Representations of Customs Conversion Routines

7. Understanding .NET Assemblies: Problems with Classic COM Binaries, An Overview of .NET Assembly, Building a Simple File Test Assembly, A C#, Client Application, A Visual Basic .NET Client Application, Cross Language Inheritance, Exploring the CarLibrary's, Manifest, Exploring the CarLibrary's Types, Building the Multifile Assembly ,Using Assembly, Understanding Private Assemblies, Probing for Private Assemblies (The Basics), Private A Assemblies XML Configurations Files, Probing for Private Assemblies (The Details),Understanding Shared Assembly, Understanding Shared Names, Building a Shared Assembly, Understanding Delay Signing, Installing/Removing Shared Assembly, Using a Shared Assembly.

TEXT BOOKS:

1. Andrew Troelsen: Programming C# with .NET 3.0, 4th Edition, Wiley India, 2009.
2. E. Balagurusamy: Programming in C#, 2nd Edition, Tata McGraw Hill, 2008.

REFERENCE BOOKS:

1. Tom Archer: Inside C#, WP Publishers, 2001.
2. Herbert Schildt: C# - The Complete Reference, Tata McGraw Hill, 2004.

STOCHASTIC MODELS AND APPLICATIONS

Subject Code: 10SCN152	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Introduction: A Speech Recognition System, A Radar System, A Communication Network

2. Introduction to Probability Theory: Experiments, Sample Spaces, and Events, Axioms of Probability, Assigning Probabilities, Joint and Conditional Probabilities, Bayes's Theorem, independence, Discrete random Variables, Engineering Application: An Optimal Communication System

3. Random variables, Distributions, and Density Functions: The Cumulative Distribution Function, The Probability Density Function, The Gaussian Random Variable, Other Important Random Variables, Conditional Distribution and Density Functions, Engineering Application: Reliability and Failure Rates

4. Random Processes: Definition and Classification of Processes, Mathematical Tools for Studying Random Processes, Stationary and Ergodic Random Processes, Properties of the Autocorrelation Function, Gaussian random Processes, Poisson Processes, Engineering Application: Shot Noise in a *p-n* Junction Diode

5. Markov Processes: Definition and Examples of Markov Processes, Calculating Transition and State Probabilities in Markov Chains, Characterization of Markov Chains, Continuous Time Markov Processes, Engineering Application: A Telephone Exchange

6. Poisson Processes, Queuing Theory: The non-stationary Poisson process; The stationary Poisson process; Some Poisson process computations; Classifying the events of a non-stationary Poisson process; Conditional distribution of the arrival times. Queuing Theory: Introduction; Preliminaries; Exponential models; Birth-and-Death exponential queuing systems; The backwards approach in exponential queues; A closed queuing network; An open queuing network; The M/G/1 queue; Priority queues.

7. Simulation Techniques: Computer Generation of Random Variables, Generation of Random Processes, Simulation of Rare Events, Engineering Application: Simulation of a Coded Digital Communication System.

TEXT BOOKS:

1. Scott L. Miller, Donald G. Childers: Probability and Random Processes With Applications to Signal Processing and Communications, Elsevier, 2004.
2. Sheldon M. Ross: Probability Models for Computer Science, Elsevier, 2002.

REFERENCE BOOKS:

1. R. W. Wolff: "Stochastic Modeling and Queuing Theory", Prentice Hall, 1989.
2. B. R. Bhat: "Stochastic Models Analysis and Applications", New Age International, 2000.

SYSTEM MODELING AND SIMULATION

Subject Code: 10SCN153	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Introduction: When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Some recent applications of Simulation; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study.
2. General Principles: Concepts in Discrete-Event Simulation, List processing.
3. Statistical Models in Simulation: Review of terminology and concepts; Useful statistical models; Discrete distributions; Continuous distributions; Poisson process; Empirical distributions.
4. Queuing Models: Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.
5. Random-Number Generation, Random-Variate Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers
Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.
6. Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate and Time-Series input models.
7. Verification, Calibration, and Validation of Simulation Models: Model building, verification, and validation; Verification of simulation models; Calibration and validation of models.
Optimization via Simulation
8. Estimation of Absolute Performance: Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations.
9. Case Study: Simulation of networked computer systems.

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010.

REFERENCE BOOKS:

1. Lawrence M. Leemis, Stephen K. Park: "Discrete – Event Simulation: A First Course", Pearson Education, 2006.
2. Averill M. "Law: Simulation Modeling and Analysis", 4th Edition", Tata McGraw-Hill, 2007.

SCHEME OF TEACHING AND EXAMINATION FOR
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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	
10SCN21	Wireless & Mobile Networks	04	02	--	03	50	100	150
10SCN22	Client-Server Programming	04	02	--	03	50	100	150
10SCN23	Optical Networks	04	--	02	03	50	100	150
10SCN24	Switching & Statistical Multiplexing in Telecommunications	04	--	02	03	50	100	150
10SCN25x	Elective – II	04	--	02	03	50	100	150
10SCN26	*Project Phase-I(6 Week Duration)	--	--		--			
10SCN27	Seminar			03		50	--	50
Total		**20**	**04**	**09**	**15**	**300**	**500**	**800**

Elective – II

10SCN251 Distributed systems

10SCN252 Computer Systems Performance Analysis

10SCN253 Web 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

II SEMESTER

WIRELESS & MOBILE NETWORKS

Subject Code: 10SCN21 **I.A. Marks : 50**
Hours/Week : 04 **Exam Hours: 03**
Total 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.

Laboratory Work:

1. Using any package like MATLAB or using any programming language of your choice, implement the BPSK algorithm and study its performance.
2. Repeat the above experiment for QPSK algorithm and compare its performance with that of BPSK.
3. Using any Network simulation package or using any programming language of your choice, implement and study the performance of PRMA.

Mini Project: Using any platform like ANDROID, J2ME etc, implement any mobile application like Location Based Services, Emergency Services, Remote Monitoring etc.

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 Telecommunications 1998.
2. William Stallings: Wireless Communications and Networks**,** Pearson Education Asia, 2002.

CLIENT-SERVER PROGRAMMING

Subject Code: 10SCN22	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts

2. Concurrent Processing in Client-Server software: Introduction, Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design, Concurrency and Asynchronous I/O.

3. Program Interface to Protocols: Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIX I/O with TCP/IP.

4. The Socket Interface: Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in a Program, Symbolic Constants for Socket Call Parameters.

5. Algorithms and Issues in Client Software Design: Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by Name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability.

6. Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service, A UDP Client for the ECHO Service.

7. Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs Iterative Servers, Connection-Oriented Vs Connectionless Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types

of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations.

8. Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server.

9. Iterative, Connection-Oriented Servers (TCP): Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability.

10. Concurrent, Connection-Oriented Servers (TCP): Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes

Laboratory Work:

1. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple iterative connectionless server and demonstrate its functioning.
2. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple iterative connection-oriented server and demonstrate its functioning.
3. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple concurrent connection-oriented server and demonstrate its functioning.
4. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple Day / Time Server and demonstrate its functioning.
5. Repeat the above problems using JAVA networking facilities.

TEXT BOOK:

1. Douglas E.Comer, David L. Stevens: Internetworking with TCP/IP – Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSI C, 2nd Edition, Pearson, 2001.

OPTICAL NETWORKS

Subject Code: 10SCN23	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total 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 End-to-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.

SWITCHING & STATISTICAL MULTIPLEXING IN TELECOMMUNICATIONS

Subject Code: 10SCN24	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Introduction: Evolution of Telecommunication, Simple Telephone Communication, Basics of a Switching System, Manual Switching System, Major Telecommunication Networks

2. Why Digital? Advantages of Digital Voice Networks, Digital Signal Processing, Disadvantages of Digital Voice Networks.

3. Switching: Crossbar Switching, Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Crosspoint Technology, Crossbar Exchange Organization

4. Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two-stage, Three-stage and n-stage Networks.

5. Digital Transmission and Multiplexing: Sampling, Quantization and Binary Coding, Quantization Noise, Companding, Differential Coding, Vocoders, Pulse Transmission, Line Coding, Time Division Multiplexing.
6. Time Division Switching: Basic Division Space and Time Switching, Time Multiplexed Space and Time Switching, Combination Switching, Three-stage and n-stage Combination Switching.
7. Traffic Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems.

TEXT BOOKS:

1. Thiagarajan Viswanathan: Telecommunication Switching Systems and Networks**,** PHI, 1992.
2. John.C.Bellamy: Digital Telephony, 3rd Edition, John Wiley and Sons Inc., 2002.

DISTRIBUTED SYSTEMS

Subject Code: 10SCN251	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Characterization of Distributed Systems and System Models: Introduction, Examples of distributed systems, Resource sharing and the Web, Challenges, Architectural models, Fundamental models.
2. Networking and Internetworking: Types of Networks, Networks principles, Internet protocols, Network case studies (Ethernet, wireless LAN and ATM)
3. Interprocess Communication: Introduction, The API for the Internet protocols, External data representation and marshalling, Client -Server communication, Group communication, Case study: Interprocess communication in UNIX
4. Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, events and notifications, JAVA RMI case study
5. Operating System Support and Security: The Operating system layer, protection, processes and threads, communication and invocation , operating system architecture, overview of security techniques, cryptographic algorithms, digital signatures, cryptography pragmatics, case studies: Needham-Schroeder, Kerberos, SSL and Millicent.
6. Distributed File Systems: File service architecture, Sun Network file system, Andrew file system, Recent advances
7. Transactions and Concurrency Control: Transactions, nested transactions, locks, optimistic concurrency control, timestamp ordering, comparison of methods for concurrency control
8. Distributed Transactions: Flat and nested distributed transactions, atomic commit protocols, concurrency control in distributed transactions, distributed deadlocks, transaction recovery.
9. Distributed Shared Memory: Design and Implementation issues, sequential consistency and Ivy, Release consistency and Munin, other consistency models
10. CASE Studies: CORBA, Mach:.

TEXT BOOKS:

1. George Coulouris, Jean Dollimore, Tim Kindberg: Distributed Systems, Concept and Design, 3rd Edition, Pearson Education, 2005.

REFERENCE BOOKS:

1. Sukumar Ghosh: Distributed Systems, An Algorithmic Approach, Chapman &Hall / CRC, 2007.
2. Pradeep K. Sinha: Distributed Operating Systems, Concepts and Design, PHI, 2007.
3. Randy Chow, Theodore Johnson: Distributed Operating Systems and Algorithm Analysis, Pearson, 2009.

COMPUTER SYSTEMS PERFORMANCE ANALYSIS

Subject Code: 10SCN252	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**

Total 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 workloads: 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 Analysis: Introduction: Terminology; Common mistakes in experiments; Types of experimental designs. 2k Factorial Designs: Concepts; Computation of effects; Sign table method for computing effects; Allocation of variance; General 2k 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 processes. 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 BOOKS:

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, KS: Probability and Statistics with Reliability, Queuing and computer science Applications, 2nd Edition, Wiley India, 2001.

WEB ENGINEERING

Subject Code: 10SCN253 **I.A. Marks : 50**
Hours/Week : 04 **Exam Hours: 03**
Total Hours : 52 **Exam Marks: 100**

1. Introduction: Motivation, Categories of web applications, Characteristics of web applications.

2. Requirements Engineering: Introduction, Fundamentals, RE specifics in web engineering, Principles of RE for web applications, Adapting RE methods to web application development, Outlook.

3. Modeling Web Application: Introduction, Fundamentals, Modeling specifics in web engineering, Modeling requirements, Content modeling, Hypertext modeling, Presentation modeling, Customization modeling, Methods and tools, Outlook.

4. Web Application Architectures: Introduction, Fundamentals, Specifics of web application architectures, Components of a generic web application architecture, Layered architectures, Data-aspect architectures.

5. Technology-Aware Web Application Design: Introduction, Web design from an evolutionary perspective, Presentation design, Interaction design, Functional design, Outlook.
6. Technologies for Web Applications: Introduction, Fundamentals, Client/Server communication on the web, Client side technologies, Document-specific technologies, Server-side technologies, Outlook.
7. Testing Web Applications: Introduction, Fundamentals, Testing specifics in web engineering, Test approaches, Test scheme, Test methods and techniques, Test automation, Outlook.
8. Operation and Maintenance of Web Applications: Introduction, Challenges following the launch of a web application, Content management, Usage analysis, Outlook.
9. Web Project Management: From software project management to web project management, Challenges in web project management, Managing web teams, Managing the development process of a web application, Outlook.
10. The Web Application Development Process: Motivation, Fundamentals, Requirements for a web application development process, Analysis of the rational unified process, Analysis of extreme programming, Outlook.
11. Usability of Web Applications: Motivation, What is usability? What characterizes the usability of web applications? Design guidelines, Web usability engineering methods, Web usability engineering trends, Outlook.
12. Performance of Web Applications: Introduction, What is performance? What characterizes performance of web applications, System definition and indicators, Characterizing the work load, Analytical techniques, Representing and interpreting results, Performance optimization methods, Outlook.
13. Security for web Applications: Introduction, Aspects of security, Encryption, digital signatures, and certificates, Secure Client/Server interaction, Client security issues, Service provider security issues, Outlook.
14. The Semantic Web: Fundamentals of the semantic web, Technological concepts, Specifics of semantic web applications, Tools, Outlook.

Text Book:

1.Gerti Kappel, Birgit Proll, SiegfriedReich, Werner Retschitzegeer (Editors): Web Engineering, Wiley India, 2007.

Reference Books:

1. Roger Pressman, David Lowe: Web Engineering: A Practitioner's Approach, McGraw Hill, 2008.

SCHEME OF TEACHING AND EXAMINATION FOR
M.TECH. COMPUTER NETWORK ENGINEERING

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	
10SCN31	Network Management	04	--		03	50	100	150
10SCN32x	Elective – III	04	--		03	50	100	150
10SCN33x	Elective – IV	04	--		03	50	100	150
10SCN34	Project Phase - II	--	--					--
10SCN35	Evaluation of Project Phase-I	--	--	03		50	--	50
Total		**12**		**03**	**09**	**200**	**300**	**500**

Elective – III

10SCN321 Protocols Engineering

10SCN322 Topics in Multimedia Communications

10SCN323 Advances in Storage Area Networks

Elective – IV

10SCN331 Wireless Sensor Networks

10SCN332 Advances in Digital Image Processing

10SCN333 Topics in Analysis of Computer Networks

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

III SEMESTER

NETWORK MANAGEMENT

Subject Code: 10SCN31 **I.A. Marks : 50**
Hours/Week : 04 **Exam Hours: 03**
Total Hours : 52 **Exam Marks: 100**

1. Introduction: Analogy of Telephone Network Management, Data and Telecommunication Network Distributed computing Environments, TCP/IP-Based Networks: The Internet and Intranets, Communications Protocols and Standards- Communication Architectures, Protocol Layers and Services; Case Histories of Networking and Management – The Importance of topology , Filtering Does Not Reduce Load on Node, Some Common Network Problems; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions- Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management System platform, Current Status and Future of Network Management.

2. Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1- Terminology, Symbols, and Conventions, Objects and Data Types, Object Names, An Example of ASN.1 from ISO 8824; Encoding Structure; Macros, Functional Model

3. SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base. The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group, Functional Model

4. SNMP Management – RMON: Remote Monitoring, RMON SMI and MIB, RMONI1- RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups, RMON2 – The RMON2 Management Information Base, RMON2 Conformance Specifications.

5. Broadband Network Management: Broadband Access Networks and Technologies: Broadband Access Networks, Broadband Access Technology; HFCT Technology: The Broadband LAN, The Cable Modem, The Cable Modem Termination System, The HFC Plant, The RF Spectrum for Cable Modem; Data Over Cable

Reference Architecture; HFC Management – Cable Modem and CMTS Management, HFC Link Management, RF Spectrum Management, DSL Technology; Asymmetric Digital Subscriber Line Technology – Role of the ADSL Access Network in an Overall Network, ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management – ADSL Network Management Elements, ADSL Configuration Management, ADSL Fault Management, ADSL Performance Management, SNMP-Based ADSL Line MIB, MIB Integration with Interfaces Groups in MIB-2, ADSL Configuration Profiles.

6. Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation Techniques, Performance Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Event Correlation Techniques – Rule-Based Reasoning, Model-Based Reasoning, Case-Based Reasoning, Codebook correlation Model, State Transition Graph Model, Finite State Machine Model, Security Management – Policies and Procedures, Security Breaches and the Resources Needed to Prevent Them, Firewalls, Cryptography, Authentication and Authorization, Client/Server Authentication Systems, Messages Transfer Security, Protection of Networks from Virus Attacks, Accounting Management, Report Management, Policy-Based Management, Service Level Management.

TEXT BOOKS:

1. Mani Subramanian: Network Management- Principles and Practice, 2nd Pearson Education, 2010.

REFERENCE BOOKS:

1. J. Richard Burke: Network management Concepts and Practices: a Hands-On Approach, PHI, 2008.

PROTOCOLS ENGINEERING

Subject Code: 10SCN321	**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.

TOPICS IN MULTIMEDIA COMMUNICATIONS

Subject Code : 10SCN322	**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.

ADVANCES IN STORAGE AREA NETWORKS

Subject Code : 10SCN323	**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 Complete Guide to understanding and Implementing SANs", Wiley India, 2006

WIRELESS SENSOR NETWORKS

Subject Code: 10SCN331	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total Hours : 52	**Exam Marks: 100**

1. Introduction: Unique Constraints and Challenges, Advantages of Sensor Networks, Energy advantage, Detection advantage, Sensor Network Applications, Habitat monitoring, Wildlife conservation through autonomous, non-intrusive sensing, Tracking chemical plumes, Ad hoc, just-in-time deployment mitigating disasters, Smart transportation: networked sensors making roads safer and less congested, Collaborative Processing.
2. Key Definitions and The Problem: Key Definitions of Sensor Networks, Canonical Problem: Localization and Tracking, Tracking Scenario, Problem Formulation, Sensing model, Collaborative localization, Bayesian state estimation, Distributed Representation and Inference of States, Impact of choice of representation, Design desiderata in distributed tracking, Tracking Multiple Objects, State space decomposition, Data association, Sensor Models, Performance Comparison and Metrics.
3. Networking and Protocols: Networking Sensors, Key Assumptions, Medium Access Control, The SMAC Protocol, IEEE 802.15.4 Standard and ZigBee, General Issues, Geographic, Energy-Aware Routing, Unicast Geographic Routing, Routing on a Curve, Energy-Minimizing Broadcast, Energy-Aware Routing to a Region, Attribute-Based Routing, Directed Diffusion, Rumor Routing, Geographic Hash Tables. Infrastructure Establishment, Topology Control, Clustering, Time Synchronization, Clocks and Communication Delays, Interval Methods, Broadcasts, Localization and Localization Services, Ranging Techniques, Range-Based Localization Algorithms, Other Localization Algorithms, Location Services. Sensor Tasking and Control, Task-Driven Sensing, Roles of Sensor Nodes and Utilities, Information- Based Sensor Tasking, Sensor selection, IDSQ: Information-driven sensor querying, Cluster leader based protocol, Sensor tasking in tracking relations, Joint Routing and Information Aggregation, Moving center of aggregation, Multi-step information-directed routing, Sensor group management, Case study: Sensing global phenomena.
4. Databases: Sensor Network Databases, Sensor Database Challenges, Querying The Physical Environment, Query Interfaces, Cougar sensor database and abstract data types, Probabilistic queries, High-level Database Organization, In- Network Aggregation, Query propagation and aggregation, Tiny DB query processing, Query processing scheduling and optimization, Data-Centric Storage, Data Indices and Range Queries, One-dimensional indices, Multidimensional indices for orthogonal range searching, Non-orthogonal range searching, Distributed Hierarchical Aggregation, Multi-resolution, Partitioning, Fractional cascading, Locality preserving hashing, Temporal Data, Data aging, Indexing motion data.

5. Platforms and Tools: Sensor Network Platforms and Tools, Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms, Operating system: Tiny OS, Imperative language: nesC, Dataflow style language: Tiny GALS, Node-Level Simulators, ns-2 and its sensor network extensions, TOSSIM, Programming Beyond Individual Nodes: State-centric programming, Collaboration groups, PIECES: A state-centric design framework, Multi-target tracking problem revisited. Applications and Future Directions.

TEXT BOOKS:

1. Feng Zhao, Leonidas Guibas: Wireless Sensor Networks – An Information Processing Approach, Elsevier, 2004.

ADVANCES IN DIGITAL IMAGE PROCESSING

Subject Code : 10SCN332	**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.

TOPICS IN ANALYSIS OF COMPUTER NETWORKS

Subject Code: 10SCN333	**I.A. Marks : 50**
Hours/Week : 04	**Exam Hours: 03**
Total 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).

4. 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.

5. 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.

SCHEME OF TEACHING AND EXAMINATION FOR
M.TECH. COMPUTER NETWORK ENGINEERING

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	
10SCN41	Evaluation of Project Phase - II	--	03		50	--	50
10SCN42	Evaluation of Project Phase - III	--	03		50	--	50
10SCN43	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.