

GUJARAT TECHNOLOGICAL UNIVERSITY
MASTER OF COMPUTER APPLICATIONS (MCA)
Semester: V

Subject Name: **Advanced Networking (AN)**

Subject Code: **650010**

Learning Objectives:

- Develop strong analysis, design, implementation, testing and troubleshooting skills in students regarding TCP/IP based networks and services as relevant to the computer networking needs of the IT industry
- Establish a strong conceptual foundation of the TCP/IP protocol stack, services and related tools/technologies so as to facilitate the development of the above mentioned skills
- Give in-depth understanding of all the commonly used protocols used in the TCP/IP protocol stack
- Design and implement customized TCP/IP based application layer services
- To familiarize with security and performance issues in TCP/IP networks
- Give practical exposure through rigorous laboratory exercises involving programming, network administration assignments like server installation/configuration/troubleshooting, etc. as well as exploratory and research assignments to fulfill the above objectives in a realistic and a relevant way especially from industry and research point of view
- Create a strong conceptual foundation for TCP/IP which can be leveraged for studying advanced topics in TCP/IP, dissertation and System Development Project and further studies
- Create a strong conceptual foundation and offer maximum possible development of required theoretical and practical skills for students aspiring to make a career in Computer Networking like Network Designer, Network administrator, etc.

Prerequisites:

- Digital Data communication concepts
- An overview of the layered architecture as per OSI and TCP/IP model
- Overview of functionality of all layers in the OSI and TCP/IP model
- Differences between OSI and TCP/IP model
- Concepts of LAN, WAN, Internet, Ethernet
- General concepts in routing and basic routing algorithms like Dijkstra's shortest path, distance vector routing, link state routing, etc.
- Overview of popular application layer services like DNS, HTTP, SMTP, etc.

(All above pre-requisites are covered in the subject Fundamentals of Networking (FON) Sub Code: 640001 in GTU MCA SEM IV)

Contents:

1. Classful Internet Addresses, Mapping Internet Addresses to Physical Addresses (ARP), Internet Protocol: Connectionless Datagram Delivery (IPv4) [20%]

Introduction, Universal identifiers, IP addresses and network connections, original classful addressing scheme, special purpose IP addresses like directed broadcast and network broadcast, Limited broadcast, Loopback address, Subnet and Classless extensions, Weaknesses in Internet addressing, Dotted decimal notation, Network byte order, Special address conventions.

Concept of physical address, Address resolution problem, Relationship between network address and physical address, Two types of physical addresses, Resolution through direct mapping, Resolution through dynamic binding, ARP cache Timeout, ARP refinements, Relationship with other protocols, ARP implementation, ARP Encapsulation and identification, ARP protocol format, Automatic ARP cache revalidation

Concept and reason for connectionless and best effort delivery system at network layer, purpose of Internet protocol, IPv4 datagram format , interpretation and significance of each header fields, IP options.

2. Internet Protocol: Forwarding IP Datagrams, Error And Control Messages (ICMP), Classless And Subnet Address Extensions (CIDR), User Datagram Protocol (UDP) [20%]

Introduction, Forwarding in the Internet, Indirect and Direct delivery, Table driven IP forwarding, Next hop forwarding, Default routes, Host specific routes, IP forwarding algorithm, Forwarding with IP addresses, Handling incoming datagrams, Establishing routing tables.

Introduction of ICMP, Need for a controlling protocol, Error Reporting versus Error Correction, ICMP message delivery, ICMP message format, Ping, Formats of different type of messages like Echo(Request and Reply), Congestion , Unreachable Destinations, Source Quench, Router advertisement and Solicitation, etc..

Introduction of CIDR, Minimizing Network Numbers, Proxy ARP, Subnet Addressing, Flexibility in subnetting, Variable length subnets, Subnet masks, Unified Forwarding Algorithm, Broadcasting to Subnets, Anonymous point to point networks, Classless Addressing and Supernetting, CIDR address blocks and Bit masks, Data Structures and Algorithms for classless lookup, Searching by mask length, Binary trie structures, Longest match and mixture of route types, PATRICIA and level compressed tries.

Introduction of UDP, Need for UDP, UDP message format, UDP Pseudo header, UDP encapsulation and protocol layering, Layering and UDP Checksum computation, UDP multiplexing, demultiplexing, and role of ports in multiplexing and demultiplexing, UDP applications, port numbers of well known UDP based applications

3. Reliable Stream Transport Service (TCP), Private Network Interconnection (NAT, VPN), Bootstrap And Auto configuration (DHCP) [20%]

Introduction, Need for stream delivery, Properties of reliable delivery service, Providing reliability, Concept of sliding windows, Ports, connections and endpoints, Active and Passive opens, Segments, Streams and sequence numbers, Variable window size and flow control, TCP segment format, Out of band data, TCP options, Acknowledgment, Retransmission and timeouts, Accurate measurement of RTT, Karn's algorithm and timer backoff, Explicit feedback mechanism, Congestion control, TCP connection establishment and termination, Dealing with silly window syndrome.

Introduction to VPN, Private and hybrid networks, VPN addressing and routing,

Extending VPN technology to individual hosts, VPN with private addresses,

Introduction to NAT, NAT translation table creation, multi-address NAT, port mapped NAT, Interaction between NAT and ICMP, Interaction between NAT and Applications, NAT in presence of fragmentation, Conceptual address domains, Introduction to slirp and IPTables.

Introduction to DHCP, History of bootstrapping, Using IP to find IP Address, DHCP Retransmission Policy, DHCP Message format, Need for dynamic configuration, DHCP Lease concept, Multiple addresses and Relays, Lease renewal States, Address acquisition states, Early lease termination, DHCP options and message type, Options overload, DHCP and DNS

4. The Domain Name System (DNS), Remote Login And Desktop (TELNET, SSH), File Transfer And Access (FTP, TFTP, NFS), Electronic Mail (SMTP, POP, IMAP, MIME) [20%]

Need for DNS, Flat versus hierarchical namespace, Centralized versus distributed Names database, Delegation of authority for names, Subset authority, Internet domain Names, Top-level domains, Mapping domain names to addresses, Domain Name Resolution, Efficient translation, Caching, DNS message format, Compression, Inverse mappings, Pointer queries, DNS resource records, Dynamic DNS, DNSSec.

Introduction, Remote interactive computing, Telnet protocol, Accommodating Heterogeneity, Client side and server side control commands, Telnet options and option negotiation, SSH.

Different ways of sharing a file, Features, Process model, TCP Port numbers, Data connection and control connection, User's view of FTP, Anonymous FTP, Secure FTP, TFTP, NFS, RPC, XDR.

Introduction to E-mail protocols., Mailboxes, Names and Aliases, Alias expansion and mail forwarding, SMTP, POP, IMAP, MIME Extensions for non ASCII data, MIME Multipart messages.

5. World Wide Web (HTTP), Internet Security And Firewall Design (IPsec, SSL), A Next Generation IP (IPv6) [20%]

Importance of Web, Architectural components, URL, HTTP, HTTP methods, HTTP error messages, Connection types, Significance of different HTTP header fields, Negotiation, Conditional requests, Proxy servers, Caching, HTTP security and E- Commerce.

Introduction to IPsec and SSL, Need for Security, IPsec, AH, SA, ESP, Authentication and mutable header fields, Tunneling, Required security algorithms, SSL and TLS, Firewalls, Firewall implementation issues, Packet filtering, Stateful firewalls, proxy servers, Monitoring and logging, Introduction to IPv6, Need for new IP protocol, IPv6 features, IPv6 base header format.

Text Book (Theory):

- 1) Douglas E. Comer, "Internetworking with TCP/IP - (Vol. 1) Principles, Protocols, and Architecture", 5th Edition, Prentice Hall of India (PHI) Publishers.

Reference Books (Theory):

- 1) Behrouz A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, McGraw-Hill
- 2) W. Richard Stevens, G. Gabriani, "TCP/IP- Illustrated, Vol. 1 (The Protocols)", Pearson Publishers.

Chapter wise coverage from the Text Book:

Chapter No.	Topics/Subtopics	No. of Lectures
4	*	03
5	*	02
6	*	04
7	*	02
8	*	04
9	*	04
11	*	02
12	*	06
19	*	03
22	*	02
23	*	02
24	*	02
25	*	02
26	*	03
27	*	03
30	*	03
31	31.1 – 31.9	01
	Total No. of Lectures	48

* All topics/subtopics from the given chapter to be included in syllabus

Accomplishment of the student after completing the course:

- Have thorough understanding of TCP/IP based systems, services and related tools and technologies
- Be fluent in design and developing Java based TCP/IP socket based networking solutions
- Effectively use available OS commands/utilities as well as popular third party tools for TCP/IP networking depending upon the needs
- Be geared to adapt to more sophisticated networking related packages in Java and hence develop relatively complex applications more reliably and faster.

A suggestive list of CEC activities for AN:

1. OS commands and utilities for TCP/IP

TCP/IP commands and utilities available in any of the following OS (Microsoft Windows 2000 server/ Red Hat Linux/Fedora) A suggestive list for Windows is given below:

- ipconfig
- ping
- arp
- nslookup
- netstat
- tracert
- route print
- telnet
- ftp

Some of the above commands may vary depending upon the OS.

Students may contact different Internet services like FTP, HTTP, SMTP, Daytime, echo, quote, etc. through telnet giving appropriate host name and well known port no. and observe the interaction on command prompt

2. Server Administration & Client Configuration

- Installation, configuration and operation of :
 - 1) Web Server (Preferably free and open source like Apache)
 - 2) FTP Server (Preferably free and open source like FileZilla)
- Configuring a new TCP/IP client (preferably windows or Linux)
Configuring IP address/s, default gateway, DNS server addresses, DNS suffix, subnet mask, proxy information, etc.

Installation, configuration and operation of non web based email clients like Outlook Express.