GUJARAT TECHNOLOGICAL UNIVERSITY

Syllabus for Integrated MCA 4th Semester
Subject Name: Computer Networking (CN)
Subject Code: 2648603

1. Learning Objectives:
- To equip the students with basics concept of Computer Networks.
- To familiarize the students with the standard models for the layered approach OSI and TCP/IP to communication between machines in a network and the protocols of the various layers.
- To gain basic insight of programming for network solutions.

2. Desirable
1. Basic Concept of Data Structures, Operating systems, Programming Language and Knowledge of Linux OS.

3. Course Contents:

Unit	Course Content	Weightage Percentage
Unit I	**Introduction:** Computer Network Applications, Personal Area Network, Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network software, protocol hierarchies, Design issues for the layers, connection oriented vs. Connectionless service, service primitives, relationship of services in protocols, Reference Models, Open System Interconnection (OSI), TCP/IP Reference models	10%
Unit II	**Physical Layer:** Maximum Data Rate of a Channel, Guided Transmission Media, Magnetic Media, Twisted Pairs, Coaxial Cable, Fiber Optics, Wireless Transmission, Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared Transmission, Baseband Transmission, Structure of PSTN, Circuit Switching and Packet Switching, Mobile Communications (1G, 2G, 3G)	15%
Unit III	**Data Link Layer:** Design issues, Error detection and correction. Elementary data link protocols: Utopian simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel. Sliding Window protocols,	15%
Unit IV	**Medium Access Control Sublayer:** The channel allocation problem, ALOHA, CSMA protocols, Wireless LAN Protocols, Ethernet (Classic, frame format, MAC sub layer, Performance, switched, Fast), IEEE 802.11 Architecture and Protocol Stack, MAC sublayer, Frame Structure, Services, IEEE 802.16 Broadband Wireless – Comparison with IEEE 802.11, Architecture and Protocol Stack, Bluetooth – Architecture, Applications, Protocol Stack, Data link layer switching (Repeaters, Hubs, Switches, etc.).	15%
Unit V	**Network Layer:** Design issues, Routing algorithms: Optimality principle, shortest path routing, Flooding, distance vector routing, Link State routing, Congestion Control Algorithms (overview), Quality of Service (Overview), The Network layer in the Internet (Ipv4 Protocol, Addresses, Ipv6, Internet Control Protocols.	15%
Unit VI	**Transport Layer:** Services Provided to Upper Layers, Primitives, Introduction to UDP, RPC, TCP (Except Connection Management Modeling).	15%

Unit VII	**Application Layer:** Domain name system, Electronic Mail, World Wide Web	**15%**

4. Text Book(s):

1) Andrew S Tanenbaum, David. J. Wetherall, "Computer Networks", Pearson Education, 5th Edition,

5 Suggested Additional Reading:

1) Bhushan H Trivedi ,"Computer Networks", Oxford University Press
2) Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition
3) Kurose and Ross,Computer Networking- A Top-Down approach, Pearson, 5th edition
4) Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers, Fifth Edition, 2011.
5) Fred Halsall,Computer Networking and the Internet, Addison Wesley, (5th edition)
6) Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011

6. Chapter wise Coverage from the Text Book:

Unit #	Chapter
I	Chapter 1: 1,2,3,4.1 to 4.4
II	Chapter 2: 1.3, 2 (except 2.4), 3.1 to 3.4, 5.1, 6.1, 6.5, 7
III	Chapter 3: 1,2,3,4
IV	Chapter 4: 1,2.1, 2.2, 2.5,3.1 to 3.5 ,4 (except 4.2), 5.1, 5.2 ,6.1,6.2,6.3, 8.4
V	Chapter 5: 1,2.1 to 2.5,3.1, 4.1, 6.1 to 6.4
VI	Chapter 6: 1.1,1.2, 4.1, 4.2,5.1 to 5.10 (except 5.7)
VII	Chapter 7: 1,2,3

Students are not required to reproduce the entire algorithms/protocol code in the theory exam for any protocols and routing algorithms. Concepts based on these algorithms/ protocols should be asked in theory exam.

7. Outcomes

At the end of the course, the student should be able to:

- Understand concepts of networking and gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Identify the components required to build different types of networks
- Obtain the skills of subnetting and routing mechanisms.
- Have a working knowledge of datagram
- Trace the flow of information from one node to another node in the network

Practical List

Part I: Network Basics

    A) Hardware (Hands On)
1. Install & Test Network Interface Card.
2. Prepare and Test Straight UTP Cable.
3. Prepare and Test Cross UTP Cable.
4. Conceptualize, Design, Install, Configure and Test a small (4-5 nodes) Wired (Ethernet) Network. (Windows Server/Ubuntu Server/Red Hat Server/Fedora Server Based). Apply appropriate OS Server settings as per your requirements including security/access rights settings.

    B) Software (Any one of the below)
1. Install, Configure and Test an FTP Server. (Preferably FileZilla)
2. Install, Configure and Test a Web Server (Preferably Apache)
3. Conceptualize, Design, Install, Configure and Test a small Wi-Fi network (Not Necessary to use AP, Non Infrastructure Mode)

C)   TCP/IP OS Diagnostic Commands: ping, ipconfig, nslookup, tracert, netstat, arp, ftp, telnet.

For above Part1, appropriate documentation needs to be maintained. Viva marks in Practical will be based on it.

Part II: Network Analysis using Wireshark

1. Download Wireshark from its official webpage, It is a network packet analyzer
https://www.wireshark.org/
2. Install Wireshark under Windows/Linux/MAC/Solaris platform. Install WinPcap.

Lab1:

Objective: To make the students aware about the IT/Network infrastructure of their parent institute.

Introduction to the lab infrastructure, the cabling/cable type and specifications/ switch/ topology/ router/network infrastructure, Internet Connectivity, Wi-fi Connectivity of your department (labs and lecture halls) and how it is connected with the overall institute level IT infrastructure, How the institute obtains Internet Connectivity from its ISP, The Bandwidth and other specifications, Visit to the Computer Center of the Institute, Introduction to various Enterprise Servers/Servers of Licensed Software, Server hardware configuration, Server Management Tools, Enterprise Level Firewall, etc. So, lab 1 is intended as an in-campus IT infrastructure industrial visit for students. Students are supposed to prepare a report of this visit. Students are also supposed to note down the model/make of various network interface devices (NIC card, switch, router) used in their lab/department/institute, download their technical specifications from their respective web-site and attach those specifications in the report. The significance and interpretation of these specifications may be discussed by the faculty member during the corresponding lab/lecture hours pertaining to that particular device.

Lab 2:
Objective: Wireshark Installation, understanding the Wireshark Environment / Menu System, to start and stop live capture of traffic from given wired ethernet network interface, capturing options, store captured data in different supported file formats, to open already stored captured data file.

Lab 3:
Objective: Learn and use view level filters and capture level filters in Wireshark for different traffic types like Ethernet, ARP, IP, TCP, UDP, DNS, HTTP, etc. For each captured category, observe how different headers are encapsulated within each other. Eg. TCP encapsulated within IP, HTTP encapsulated within TCP, etc.

Lab 4:
Objective: Capture and Analyze the following traffic types and Interpret/ Analyze the corresponding header and payload: Ethernet, ARP, IP, ICMP

Lab 5:
Objective: Capture and Analyzethe following traffic types and Interpret/ Analyze the corresponding headerand payload: TCP, UDP, HTTP, DNS

Lab 6:
Objective: Capture and Analyze the following traffic types and Interpret/ Analyze the corresponding headerand payload: FTP, SMTP and Telnet

Note:
Some of the practicals form the above practical list may have seemingly similar definitions. For better learning and good practice, it is advised that students do maximum number of practicals. In the practical examination, the definition asked need not have the same wordings as given in the practical list. However, the definitions asked in the exams will be similar to the ones given in the practical list.

Part III: Exploring using Python (Lab 7 to Lab 10)

1. Implement a Python Program to print host name and IP address of local host.

2. Implement a Python Program to print host name and IP address of remote host where IP address of remote host is available.

3. Implement a Python Program to print host name and IP address of remote host where hostname of remote host is available.

4.   Implement a TCP port scanner program in python for local host.
    (Note: Do not try this program for a remote host, especially outside your domain. It could cause legal problems)

5. Implement a UDP port scanner program in python for local host.

6. (Note: Do not try this program for a remote host, especially outside your domain. It could cause Legal problems)

7. Implement a TCP based client server program in python using TCP sockets where Server displays the following: a) Host Name, IP address and Port Number on which it is hostedb) IP address and port number of a client requesting connection. Server sends the message"Thanks for Connecting!" back to client. Client displays this message on screen.

8. Implement a UDP based client server program in python using UDP sockets where Server displays the following:
   a) Host Name, IP address and Port Number on which it is hosted
   b) IP address and port number of a client sending some dummy message. Server displays the dummy message on screen. Server sends the message "Thanks for Message!" back to client. Client displays this message on screen.

9. Implement a TCP based echo client server program in python.

10. Implement a UDP based echo client server program in python.

11. Implement a TCP based daytime client server program in python.

12. Implement a UDP based daytime client server program in python.

13. Implement a TCP based client server text chat program in python.

14. Implement a UDP based client server text chat program in python.

15. Implement a TCP based echo client server program in python with a multi-threaded server.

16. Implement a TCP based daytime client server program in python with a multi-threaded server.

17. Implement a web client using urllib to:
   a) Display the html source of a given URL on screen
   b) Display the URL visited
   c) Display the header information transmitted in the http response sent by the contacted
   d) web-site/web-server.
   e) Display the http server status code

18. Implement an ftp client using ftplib which connects to an ftp server, takes login/ password from user, and displays directory list and permits upload and download of files.

19. Write a Python program that makes a connection to a web server and retrieve/display a document using the HTTP protocol.

20. Write a Python program that makes a connection to a web server and retrieve an image using the HTTP protocol.

Reference Material for Python Network Programming:

1. Learning Python Network Programming, Dr. M.O. FaruqueSarker& Sam Washington, Packt Publishing, 2015
2. Python Network Programming Cookbook, 2nd Edition, PradeebanKathiravelu, Dr. M.O. FaruqueSarker, Packt Publishing, 2017
3. Foundations of Python Network Programming, 3rd edition, Brandon Rhodes & John Goerzen, Apress Publications
4. Beginning Python: From Novice to Professional, 2nd edition, 2009 (Indian Reprint), Apress Publications
5. https://docs.python.org/3/howto/sockets.html
6. https://docs.python.org/3/library/socket.html