Program Name   : Computer Engineering Program Group / Diploma in Computer Hardware & Maintenance / Diploma in Artificial Intelligence and Machine Learning

Program Code   : CO/CM/IF/CW/HA/AN

Semester   : Fourth

Course Title   : Data Communication and Computer Network

Course Code   : 22414

1.   RATIONALE

A data communication and computer networks has been growing with rapid technological progress. Computer communication through networking becomes essential part of our life. By considering importance of networking in day today life, it is essential for students to know the basic concept of networks like network classification, network topologies, network devices, This course deal with the important concepts and techniques related to data communication and enable students to have an insight in to technology involved to make the network communication possible.

2.   COMPETENCY

The aim of this course is to help the student to attain the following *industry identified* competency through various teaching learning experiences:

- **Maintain data communication and computer network**

3.   COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

   a.   Analyze the functioning of data communication and computer network.
   b.   Select relevant transmission media and switching techniques as per need.
   c.   Analyse the transmission errors with respect to IEEE standards.
   d.   Configure various networking devices.
   e.   Configure different TCP/IP services.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Paper Hrs.	Theory						Practical					
L	T	P			ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): *Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.*

Legends: L-*Lecture;* **T** – *Tutorial/Teacher Guided Theory Practice;* **P** - *Practical;* **C** – *Credit,* **ESE** - *End Semester Examination;* **PA** - *Progressive Assessment.*
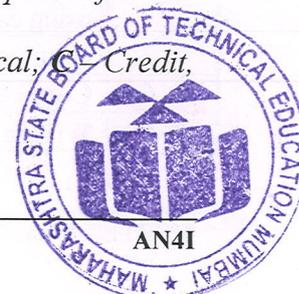
5.   COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map:
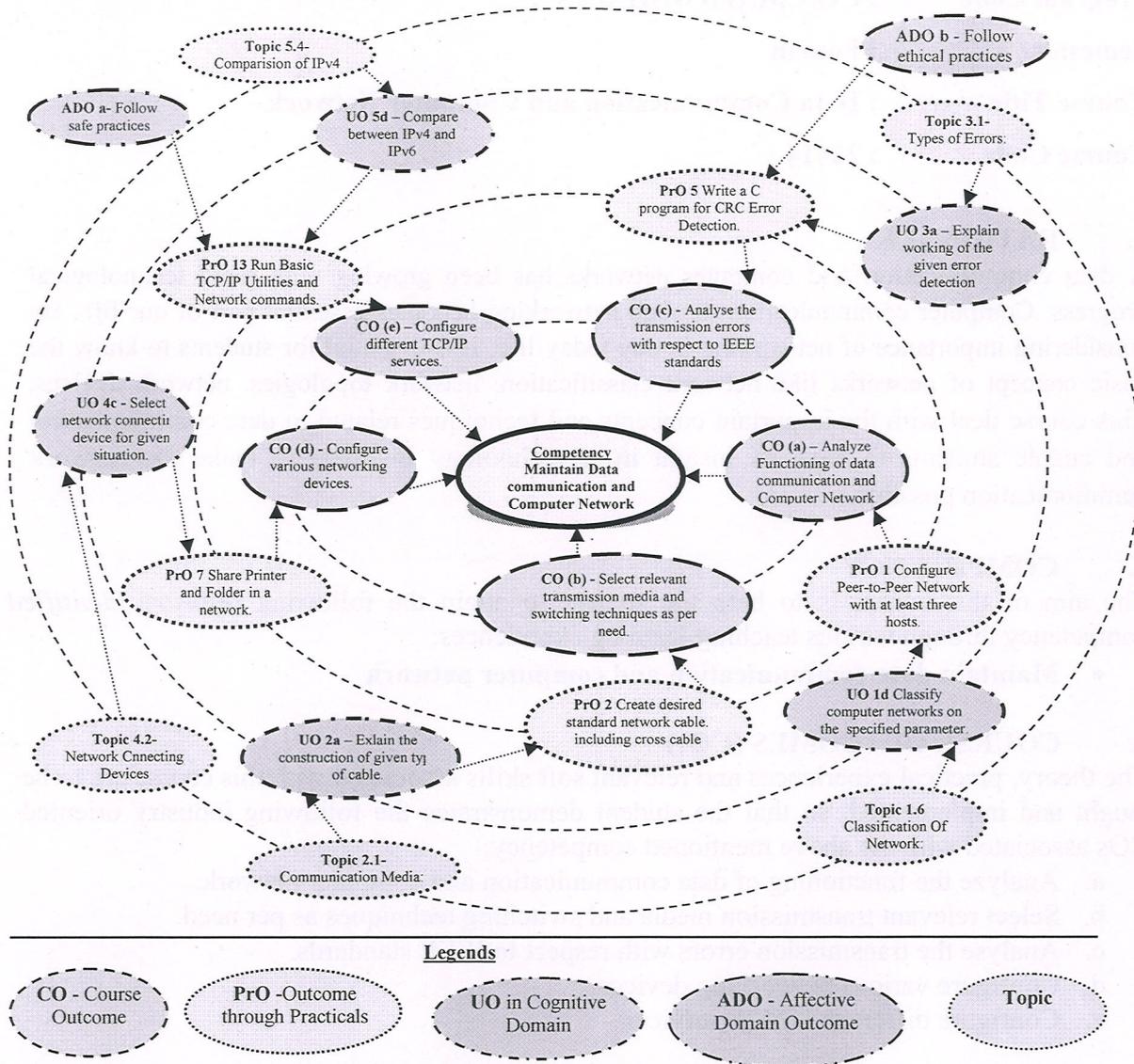

Figure 1 - Course Map

6.   SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Configure Peer-to-Peer Network with at least three hosts.	I	02*
2.	Create desired standard network cable including cross cable and test by using cableTester	II	02*
3.	Connect Computers using given topology with wired media	III	02*
4.	Connect Computers using wireless media	III	02
5.	Write a C program for CRC Error Detection.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6.	Create a Network Using Bluetooth-(Piconet/Scatternet)	III	02
7.	Share Printer and Folder in a network and transfer a file from one computer to another.	IV	02*
8.	Install operating system(Windows/Linux-RedHat/Ubuntu)	IV	02*
9.	Configure File Server	IV	02
10.	Configure Client To File Server and use file services.	IV	02
11.	Configure Static and Dynamic IP addresses	V	02*
12.	Configure DHCP server.	V	02*
13.	Run Basic TCP/IP Utilities and Network commands : ipconfig, ping , tracert, netstat, pathping, route	V	02*
14.	Install Wireshark and configure as packet sniffer	V	02
15.	Set access rights and security permissions for user	V	02
16.	Create IPV6 based small computer network using a simulator (prferebaly open source based simulator)	V	02
17.	Setting up a wireless network	IV	02
	Total		**34**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Effective practical implementation within specified time	60
b.	Effective handling of network component	10
c.	Answer to sample questions	20
d.	Submit report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

    a. Follow safety practices.
    b. Handle network components carefully.
    c. Demonstrate working as a leader/a team member.
    d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

• 'Valuing Level' in 1st year
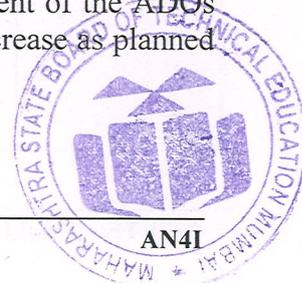
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1.1	Computer system (Any computer system with basic configuration)	All
1.2	Network connecting device, transmission media	All
1.3	Network cable Tester, crimping tool, RJ-45 connectors, Ethernet cable	2
1.4	Wireshark sniffing tool	15

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of Data Communication and Computer Network	1a. Describe role of the given component in the process of data communication. 1b. Compare the characteristic of analog and digital signals on the given parameter. 1c. Explain the process of data. communication using the given mode. 1d. Classify computer networks on the specified parameter. 1e. Select network architecture for the given situationwith justificsation.	1.1 Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocol. 1.2 Protocols, Standards, Standard organizations.Bandwidth, Data Transmission Rate, Baud Rate and Bits per second. 1.3 Modes of Communication (Simplex, Half duplex, Full Duplex). 1.4 Analog Signal and Digital Signal, Analog and Digital transmission:Analog To Digital ,Digital To Analog Conversion 1.5 Fundamental Of Computer Network: Definition And Need Of Computer Network,Applications,Network Benefits. 1.6 Classification Of Network: LAN,WAN,MAN 1.7 Network Architechture:Peer To Peer, Client Server Network
Unit-II Transmission Media and Switching	2a. Explain with sketches the construction of given type of cable. 2b.Explain with sketches the characteristics of the given type of unguided transmission media. 2c. Explain with sketches the working of the given	2.1 Communication Media: Guided Transmission Media Twisted-Pair Cable, Coaxial Cable Fiber-Optic Cable 2.2 Unguided Transmssion Media Radio Waves, Microwaves, Infrared, Satellite 2.3 Line-of-Sight Transmission:Point to Point, Broadca

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Multiplexing technique. 2d. Describe with sketches the working principle of the given switching technique. 2e. Compare different Switching techniques on the given parameter.	2.4 Multiplexing: Frequency-Division Multiplexing Time -Division Multiplexing 2.5 Switching: Circuit-switched networks, Packet -swtiched networks
Unit– III Error Detection,Correction and Wireless Communication	3a. Explain working of the given error detection and correction method. 3b. Explain features of the given IEEE communication standard. 3c. Explain characteristics of the given layer in IEEE 802.11 architecture. 3d. Compare the specified generations of mobile telephone system on the given parameter. 3e. Explain with sketches the process of creating Bluetooth environment using the given architechture.	3.1 Types of Errors:Single Bit Error and Burst Error, Redundancy 3.2 Error Detection:Longitudinal Redundancy Check(LRC),Vertical Redundancy Check(VRC),Cyclic Redundancy Check(CRC)Forward 3.3 Error Correction: Forward error Correction 3.3 IEEE standards: 802.1, 802.2, 802.3, 802.4, 802.5 3.4 Wireless LANs: 802.11 Architecture, MAC Sublayer,Addressing Mechanism 3.5 Bluetooth Architecture: Piconet, Scatternet 3.6 Mobile Generations: 1G, 2G, 3G, 4G and 5G
Unit– IV Network Topologies And Network Devices	4a. Identify relavent network topology for the given situation. 4b. Compare different topologies on the given parameter. 4c. Select network connecting device for the given situation. 4d. Describe with sketches the procedure to configure the given networking device.	4.1 Network Topologies : Introduction, Definition, Selection, Criteria, Types of Topology- i) Bus ii) Ring iii) Star iv)Mesh v)Tree vi)Hybrid 4.2 Network Connecting Devices:Hub, Switch, Router, Repeater, Bridge, Gateway, Modem, Wireless infrastructure Components
Unit –V Reference Models	5a. Identify functions and features of the given layer of OSI Reference model. 5b. Compare the specified service on the given parameters. 5c. Classify IP Addresses on the basis of its class from the given set of addresses.	5.1 OSI Reference Model: Layered Architecture , Peer-to- Peer Processes-Interfaces between Layer, Protocols, Organization of the Layers, Encapsulation Layers of the OSI Reference Model (Functions and features of each Layer) Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5d. Distinguish between IPv4 and IPv6 on the given parameters. 5e. Describe with sketches the procedure to configure the given TCP/IP service.	Layer 5.2 TCP/IP Model: Layered Architechture: Data Link Layer:Nodes and links,services,two categoriesof links,two sub layers, Link layer addressing:three types of addresses,address resolution protocal(ARP), Network Layer: Addresses: address space,classful and classless addeessing, dyanamic host configuration protocol(DHCP), network address resolution(NAT). Transport layer protocal:transport layer services, connectionless and conection oriented protocol. 5.3 Introduction –Addressing mechanism in the Internet IP Addressing – IP Address classes, classless IP addressing, Subnetting, supernetting, Masking, 5.4 IPv4 and IPv6 5.5 OSI and TCP / IP Network Model.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

## 9.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamental Of Data Communication And Computer Network	10	04	04	04	12
II	Transmission Media and Switching	14	04	06	06	16
III	Error Detection,Correction and Wireless Communication	14	02	04	06	12
IV	Network Topologies And Network Devices	10	02	04	04	10
V	Reference Models	16	06	06	08	20
	Total	**64**	**18**	**24**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10.   SUGGESTED STUDENT ACTIVITIES
Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare
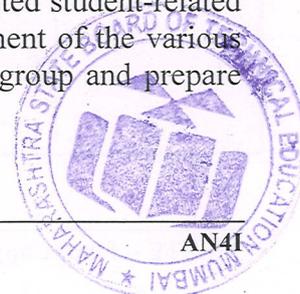
reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

    A. Prepare specification table for Guided media and Unguided media.
    B. Classify network connecting devices with their specifications.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

    a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
    b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
    c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
    d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
    e. Use animations to explain various network topologies,OSI Layers,network connecting devices.
    f. Guide student(s) in undertaking micro-projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

    The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

    A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

    a. Create a small Network install, configure various devices and perform at least one peer-to-peer service and client/server service over it.
    b. Prepare a report on recent and widely used Unguided media in industries depending on Cost, speed, efficiency, reliability.
    c. Design layout of a Network for department, Deciding upon type of network, number/length of components with their specifications.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Data communications and	Forouzan	Tata McGraw Hill, New Delhi,

S. No.	Title of Book	Author	Publication
	networking.	Behrouz A.	2006, ISBN : 9780-07-296775-3
2	Computer Networks	Tanenbaum Andrew S.	PHI Learning Pvt Ltd, Delhi ISBN-13: 978-0-13-212695-3
3	Data Communication and Networks	Godbole Achyut	Tata McGraw Hill, New Delhi, 2006, ISBN : 0070472971
4	Internetworking with TCP/IP Principles, Protocols and Architechtures	Comer Douglas E.	PHI Learning Pvt Ltd, Delhi ISBN: 81-203-2065-4
5	Computer Networking	T. M. Bansod	---

14.   SUGGESTED SOFTWARE/LEARNING WEBSITES

a.   www.nptelvideos.in/2012/11/data-communication.html

b.   http://www.myreadingroom.co.in/notes-and-studymaterial/68-dcn/750-analog-to-analog-conversion-techniques.html

c.   http://www.tutorial-reports.com/wireless/wlanwifi/wifi_architecture.php

d.   http://standards.ieee.org/about/get/802/802.11.html

e.   www.tutorialspoint.com/data_communication_computer_network/

f.   http://www.studytonight.com/computer-networks/overview-of-computer-networks

g.   http://whirlpool.net.au/wiki/windows_nw_diag_cmds

h.   http://nptel.ac.in/downloads/106105080/

i.   http://scanftree.com/programs/c/c-program-to-implement-crc-cyclic-redundancy-code/