NIRMA UNIVERSITY

Institute:	School of Technology
Name of Programme:	BTech CSE (Artificial Intelligence & Machine Learning)
Course Code:	XXXX
Course Title:	Data Communication and Networking
Course Type:	Core
Year of Introduction:	2025-26

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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to:

1. describe the fundamental components, topologies, and network models (BL2)
2. demonstrate signal transmission methods (BL3)
3. analyse protocols related to various network architecture layers (BL4)
4. design computer networks. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction**: Components of the network, its types, topology, and protocol. **Network models:** OSI reference model, TCP/IP protocol suite, applications of Data Communications and Networking	05
Unit-II	**Data and signal:** Types of analog and digital signals and their characteristics, transmission of digital signal, data rate limits, signals in time and frequency domain, transmission impairment, performance measurement of network	05
Unit-III	**Digital transmission**: Digital to digital and Analog to digital conversion, transmission modes **Analog transmission:** Digital to analog and Analog to analog conversion, and Modulations Multiplexing, Spread Spectrum techniques, Switching techniques, types of switches, and structure of a switch **Error detection and correction:** Detection versus correction, coding, block coding, cyclic codes.	10
Unit-IV	**Data Link Layer:** Introduction and link layer services, two sublayers, link layer addressing, overview of sliding window protocols, multiple-access protocols: Random-access Protocols, Controlled-acccss Protocols, Ethernet protocols and types of Ethernets.	08
Unit-V	**Network Layer:** Design Issues, packet switching, network layer performance **Routing Algorithms:** Shortest path routing, Flooding, Distance Vector routing, Link State routing Congestion control algorithms, Internetworking **Example protocols:** IPv4 and IPv6, classfull addressing, classless addressing, subnetting, IP Datagram format, fragmentation, NAT.	10

Unit-VI	**Transport Layer:** Transport service, transport layer protocols for flow control, Elements of transport protocols, congestion control **Example protocols:** UDP, TCP.	07

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content

Suggested Readings/ References:

1. Behrouz Forouzan, Introduction to Data Communication and Networking, McGraw-Hill
2. Andrew S Tanenbaum, Computer Networks, Prentice Hall
3. William Stallings, Data and Computer Communication, Prentice Hall
4. Schweber W.L., Data Communication, McGraw-Hill
5. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication, Oxford University Press.
6. Behrouz Forouzan, TCP/IP Protocol Suite, TMH Publication
7. Jim Kurose, Computer Networking: A top-down approach, Pearson

Laboratory Work:

Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated. The students in a suitable group size will design and perform one experiment as a part of Laboratory work.

Sr. No.	List of Experiments/Exercises	Hours
1	Hands-on practice of signals and their properties in MATLAB/Scilab: Amplitude, Phase, and Frequency of Pure and Composite signals	02
2	Implementation of analog modulation techniques (using MATLAB/Scilab): a) Implement amplitude, frequency, and phase modulation. b) Identify the difference between them by comparing the results in terms of bandwidth	04
3	To study the behaviour of generic devices used for networking: (CISCO PACKET TRACER) Design a simple network with multiple nodes and connect via generic devices available in the library. Perform a simulation and trace the communication behaviour of specified network devices. a. Use only HUB to design a small network having 4 to 6 hosts b. Use only a Switch to design a small network with 4 to 6 hosts. c. Use both the device (hub and switch) in a network and identify the functional difference between the switch and the hub.	02
4	Experiments with the Packet Capture Tool: Wireshark. To understand the features of Wireshark as a packet capture tool and understand the encapsulation of information. Also, study the effect of a few network commands. a) Capture live network packets using Wireshark or tcpdump and build a dataset containing normal and suspicious traffic. Extract features such as protocol type, source/destination IP, port numbers, packet length, and flag bits. Train a machine learning classifier (e.g., Decision Tree, Random Forest, or KNN) to distinguish	04

between benign and malicious packets. Test the classifier on new captures to evaluate its detection accuracy.
Capture the data live using either W*ireshark* or *tcpdump*

b) Use existing data sets: *NSL-KDD*, *CICIDS 2017*, or *UNSW-NB15* (these are standard intrusion detection datasets with packet-level features) for the analysis.

5	Virtual LAN: Simulate Virtual LAN configuration using CISCO Packet Tracer Simulation.	02
6	Wireless LAN: Configuration of Wireless LAN using CISCO Packet Tracer.	02
7	Internetworking with routers: Create an internetwork in CISCO Packet Tracer with at least six networks and a) Implement static routing to forward packets from one network to any other network b) Implement dynamic routing like RIP and OSPF	04
8	Create an internetwork in which one of the networks is LAN-based. Divide this network into multiple subnets of different sizes with a common network address. Implement dynamic routing to ensure connectivity across the internet.	04
9	NAT-PAT: Demonstrate Network Address Translation (NAT) and Port Address Translation (PAT) using CISCO Packet Tracer simulation.	02
10	Create client server application using socket programming with multi-threading.	04