COMPUTER NETWORK & DATA COMMUNICATION **Course Code : 316338**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ TE**
Semester	**: Sixth**
Course Title	**: COMPUTER NETWORK & DATA COMMUNICATION**
Course Code	**: 316338**

I. RATIONALE

Computer Networks and Data Communication is crucial for modern communication services, enabling efficient information exchange and collaboration across devices. Through this course students will be able to select, classify, install, troubleshoot and maintain various data communication networks. This course focuses on enhancing the practical skills such as configuring routers, Modem, Repeaters and switches. Troubleshooting using diagnostic tools and maintaining networks are emphasized. This course includes projects focused on troubleshooting, maintenance, and network security.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course aims to help the student to attain the following industry-identified outcomes through various teaching-learning experiences:
Maintain and troubleshoot network devices

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Implement relevant Network Topology
- CO2 - Select relevant network model and Transmission Media for data communication system
- CO3 - Troubleshoot transmission errors and flow control of the data in Data Link Layer
- CO4 - Maintain Network layer and Transport layer
- CO5 - Interprete functions of Application layer and Protocols associated with it

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316338	COMPUTER NETWORK & DATA COMMUNICATION	CND	DSC	4	-	4	2	10	5	3	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the role of the given component in the process of data communication. TLO 1.2 State two advantages of computer networking. TLO 1.3 Explain Network devices with its functions in respective layers. TLO 1.4 Describe the given topology with suitable diagram. TLO 1.5 Classify networks based on the transmission technology, physical size and architecture.	**Unit - I Fundamentals of Data Communication and Computer Network** 1.1 Data communication system and its components: Message, Protocol, Transmitter, Medium, Receiver 1.2 Need of computer networks, Network criteria, applications, advantages of networking 1.3 Network devices: Repeater, Hub, Bridge, Switches , Router, Gateway, Modem, NIC, Media Converters 1.4 Network topologies: Mesh, Star, Bus, Tree, Ring and Hybrid topologies, Schematic diagram, working, advantages, disadvantages and applications 1.5 Network Classification: • Based on Transmission Technology: Point to-point, Multipoint, Broadcast • Based on physical size: PAN, BAN, LAN, MAN, WAN, VPN, WLAN • Based on Architecture: Peer to Peer, Client Server	Lecture Using Chalk-Board Collaborative learning Presentations Video Demonstrations Program development tools and simulators

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe the functions of the given layer of OSI reference model. TLO 2.2 Explain four level addressing used in TCP/IP model. TLO 2.3 Compare TCP/IP model and OSI reference model. TLO 2.4 Describe characteristics of the given type of guided transmission media. TLO 2.5 Explain with sketches the working of the given type of modem. TLO 2.6 Compare different Switching techniques.	**Unit - II Network models and Physical layer** 2.1 The OSI Model: Layered Architecture, Encapsulation Layers in OSI Model: Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer, Functions of each layer 2.2 TCP/IP Protocol Suite: Architecture, Layers in TCP/IP Protocol Suite: Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Application Layer, Functions of each layer 2.3 Introduction to Protocols used in Network model (Enlist names only) 2.4 Addressing in TCP/IP: Physical, Logical, Port and Specific Addresses 2.5 Transmission Media: Guided Media -Twisted pair (UTP, STP) cable, Coaxial cable, Fiber-optic cable Unguided Transmission Media: Radio Waves, Microwaves, Infrared 2.6 Modems : Null Modem, Broadband modem, DSL, ADSL, HDSL, VDSL(working, configuration and the wiring diagram) 2.7 Switching: Circuit-switching, Packet Switching, Datagram approach, Virtual Circuit approach	Lecture Using Chalk-Board Presentations Collaborative learning Video Demonstrations Program development tools and simulators
3	TLO 3.1 Describe Data Link Layer services. TLO 3.2 Describe the technique of the given error control method with examples. TLO 3.3 Generate the CRC code for the given data word. TLO 3.4 Construct the Hamming code for the given data. TLO 3.5 Explain with sketches the given type of flow control used in the data link layer. TLO 3.6 Compare characteristics of given type of data link layer Protocols. TLO 3.7 Select the appropriate protocol for error free transmission of given data.	**Unit - III Data Link Layer** 3.1 Data link layer: Flow and Error control 3.2 Error control: Types of errors-Single bit and Burst errors, Redundancy • Codeword Generation- CRC, Checksum, Hamming code • Error Detection- CRC, Checksum • Error Detection and Correction- Hamming code 3.3 Flow control: Framing, Flow and Error control Protocols: • Noiseless channel: Stop-and-Wait protocol • Noisy channels: Stop and Wait Automatic Repeat Request (ARQ) protocol 3.4 Sliding window protocol: • One Bit Sliding window protocol • Go-Back-N ARQ • Selective Repeat ARQ 3.5 Point to Point Protocol(PPP): Framing and Transition phases of PPP	Lecture Using Chalk-Board Video Demonstrations Collaborative learning Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Select appropriate class for the given network size. TLO 4.2 Differentiate between classful and classless addressing with suitable example. TLO 4.3 Explain the role of NAT in address depletion. TLO 4.4 Describe transport layer services. TLO 4.5 Describe the given type of network security technique. TLO 4.6 Explain functions of firewall.	**Unit - IV Network layer and Transport layer** 4.1 Network layer Logical addressing: • IPv4 Addresses: Address space notations, Classful addressing and Classless addressing, Subnetting, Network Address Translation (NAT) • IPv6 addresses: Need for IPv6, Address space 4.2 Network layer-Multicast Routing Protocols :Unicast, Multicast and Broadcast routing and applications 4.3 Transport Layer: Process to Process delivery, TCP, UDP • Port: Addressing, Format, Operation and uses 4.4 Network security: Cryptography, Components of cryptography, Block diagram of symmetric and asymmetric cryptography 4.5 Security services: Firewalls, Types of Firewall, Packet-Filter Firewall and Proxy Firewall	Lecture Using Chalk-Board Presentations Video Demonstrations Presentations Program development tools and simulators
5	TLO 5.1 Describe functioning of DNS in internet. TLO 5.2 Explain how the working of Simple Mail Transfer Protocol is used for data transfer. TLO 5.3 Describe the importance of Message Access Agent for addressing. TLO 5.4 Explain the steps to transfer files using FTP. TLO 5.5 Explain the working of Telnet for remote logging.	**Unit - V Application Layer** 5.1 Application Layer Protocols: Domain Name System (DNS) architecture, Domain types, DNS name space, Domain name resolution & Mapping to physical addresses 5.2 Electronic Mail • Message Transfer Agent -Simple Mail Transfer Protocol (SMTP) Components, working • Message Access Agent - Post Office Protocol (POP) and Internet Message Access Protocol (IMAP), working 5.3 File Transfer Protocol (FTP), Anonymous FTP 5.4 Remote logging: Telnet	Lecture Using Chalk-Board Presentations Collaborative learning Video Demonstrations Program development tools and simulators

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install packet tracer tools and workspaces. LLO 1.2 Place and connect network devices (PCs, switches and routers).	1	*Installation and introduction of Cisco Packet Tracer	2	CO1
LLO 2.1 Install GNS3 software simulator tools. LLO 2.2 Place and connect network devices (PCs, switches, routers).	2	Installation and introduction GNS3 software simulator tools	2	CO1
LLO 3.1 Analyse the type of network topology used in your lab.	3	Identify the topology used in the computer lab	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Connect computers in Mesh topology and test the performance.	4	*Simulation of Mesh topology	2	CO1
LLO 5.1 Connect computers in Star topology and test the performance.	5	*Simulation of Star topology	2	CO1
LLO 6.1 Connect computers in Tree topology and test the performance.	6	Simulation of Tree topology	2	CO1
LLO 7.1 Install/configure/Test Peer to Peer LAN and sharing of resources.	7	*Share resources in a computer network	2	CO1
LLO 8.1 Set up a basic VPN and Connect remote clients securely using OpenVPN or Windows VPN.	8	Configuring VPN (Virtual Private Network) using simulator	2	CO1
LLO 9.1 Install and test Repeater and Bridge.	9	Installation of Repeater and Bridge	2	CO1
LLO 10.1 Execute TCP/IP network commands: ipconfig ,ping, tracert.	10	*Troubleshoot computer network using given commands	2	CO2
LLO 11.1 Execute TCP/IP network commands: route, netstat, pathping.	11	*Troubleshoot computer network using given commands	2	CO2
LLO 12.1 Prepare a straight patch cord cable to connect the devices in the LAN.	12	*Prepare a standard network straight cable by using crimping tool	2	CO2
LLO 13.1 Prepare cross-connection cables to connect the devices in the LAN.	13	*Create cross-over network straight cable by using crimping tool	2	CO2
LLO 14.1 Capture Protocol Data Unit information of the TCP/IP and OSI Model using network simulator.	14	*Use PDU tool to analyse layers of OSI Model	2	CO2
LLO 15.1 Develop and test ‘C’ program for error detection using Hamming code.	15	Implementation of the Hamming code using c programming language to detect error	2	CO3
LLO 16.1 Develop and test ‘C’ program for error correction using Hamming code.	16	*Implementation of Hamming code using c programming language to correct error	2	CO3
LLO 17.1 Write a ‘C’ program for Cyclic Redundancy Check (CRC).	17	Implement C Program for CRC	2	CO3
LLO 18.1 Configure PPP (Point to Point Protocol) on Cisco packet tracer.	18	*Use PPP Protocol to establish a direct connection between two PCs	2	CO3
LLO 19.1 Capture TCP and UDP packet using CISCO Packet Tracer.	19	Measure types of transmission delays using CISCO Packet Tracer	2	CO4
LLO 20.1 Install and test Modem and Router.	20	Installation of Modem and Router	2	CO4
LLO 21.1 Create IPv6 environment in a small network using simulator.	21	Implement IPv6 addressing scheme on a network	2	CO4
LLO 22.1 Implement Classful Address in a for class A, Class B, Class C network node in CISCO packet tracer.	22	*Implement IP addresses for intranet in Class A, Class B, Class C	2	CO4
LLO 23.1 Configure basic firewall using Windows/Linux.	23	Configuration & Testing of basic Firewall	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 24.1 Create FTP Server using network simulation software.	24	*Use the FTP protocol to transfer files from one system to another system.	2	CO5
LLO 25.1 Block/unblock specific ports and test using TELNET.	25	*Use of Packet tracer as packet sniffer	2	CO5
LLO 26.1 Implement SMTP protocol using CISCO packet tracer.	26	*Implementation of SMTP protocol using CISCO packet tracer	2	CO5
LLO 27.1 Capture ARP and ICMP packet Traffic using packet tracer or any similar network simulation software.	27	Filter ARP and ICMP packets Traffic using network simulation software	2	CO5
LLO 28.1 Configure a POP3 protocol in Packet Tracer and Test domain.	28	Configuration of POP3 protocol using CISCO Packet Tracer	2	CO5
LLO 29.1 Configure a web server and access the website using a client PC using CISCO Packet tracer.	29	Configuration of a Web Server (HTTP/HTTPS) using CISCO Packet tracer	2	CO5
LLO 30.1 Configure a DNS server in Packet Tracer and Test domain.	30	*Configuration DNS Server using CISCO Packet Tracer	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Simulation of Data Transmission: Use a network simulator (Cisco Packet Tracer or NS3) to visualize how data packets travel between devices.
- IP Addressing and Subnetting Calculator – Develop a tool that calculates subnet masks, IP ranges, and broadcast addresses for given IPs.
- Wireless Packet Capturing – Use Wireshark to capture and analyze Wi-Fi packets
- Designing a Basic VPN Network Configure a VPN connection between two remote locations. Secure the connection using encryption techniques.
- Install and configure NIC and find MAC Address of Device
- Design a network using any topology and do fault identification
- Network Topology Design – Create different hybrid network topologies using Packet Tracer.

Assignment

- For a trading firm, an organization with 10 users, draw network architecture design of wireless LAN.
- In a particular data transmission system, the data 4 received was 1011010 using 7 bit odd parity hamming code, determine the correct code
- Identify appropriate network topology and network connecting devices for following requirement. Draw network design for proposed network. An organization having its office in a building of 5 floor. Each floor it needs 20 machines. There is one File server. Each floor has 2 print servers to facilitate printer capacity using Tree topology.

Industrial visit

- Industrial visit to BSNL, ISRO, CDAC

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Network Tool Kit: Crimping Tool for RJ-45 connector, 3 in 1 modular crimping tool for RJ-45 UTP CAT-5/CAT-6 Networking Cable,LAN Cutter 8P/6pP/4P All-in-One or similar,Cable Tester/LAN Tester(Specification: Network Cable Tester for LAN RJ-45/CAT5/CAT6 UTP Wire Test Tool or similar)	13,12
2	Network Accessories: RJ45 connector, UTP cable, various connectors,1000Mbps NIC	13,12
3	Printer	7
4	Desktop Computer with basic configuration	All
5	UPS 6 KVA online	All
6	Ethernet Switch- 4/8/16/24/32	All
7	Router-256MB Memory storage capacity, compatible with Desktop and Laptop, Rack Mountable, Wireless Connectivity	All
8	Simulation Software: CISCO Packet Tracer, CORE Network Emulator, GNS3 or any other simulator	All
9	Antivirus Software (online protection with firewall securities)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of Data Communication and Computer Network	CO1	12	4	4	6	14
2	II	Network models and Physical layer	CO2	14	4	4	6	14
3	III	Data Link Layer	CO3	14	2	4	10	16
4	IV	Network layer and Transport layer	CO4	10	4	4	4	12
5	V	Application Layer	CO5	10	4	4	6	14
Grand Total				**60**	**18**	**20**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks each and average of two unit test marks will be considered out of 30 marks.

Laboratory assessment will be for 25 marks.
Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester theory examination will be for 70 marks

Laboratory assessment will be for 25 marks

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	3	3	1	1	2			
CO2	2	-	1	3	1	1	1			
CO3	2	3	2	3	1	1	1			
CO4	-	3	3	3	1	1	1			
CO5	-	-	2	3	1	1	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Behrouz A. Forouzan	Data Communication and Networking	McGraw-Hill Higher Education ISBN-13 978-0-07- 296775-3
2	Behrouz A. Forouzan	TCP/IP Protocol Suit	McGraw Hill Education ISBN-13 978-0073376042
3	A.S. Tanenbaum	Computer Networks	PRENTICE HALL ISBN-10: 0-13-212695-8 ,ISBN- 13:978-0-13-212695-3
4	Godbole Achyut and Atul Kahate	Data Communications and Networks (2nd Edition)	McGraw Hill Education ISBN-10 9780071077705,ISBN-13 978-0071077705
5	Wayne Tomasi	Introduction to Data communication and Networking	Pearson India ISBN- 978-8131709306

XIII . LEARNING WEBSITES & PORTALS

COMPUTER NETWORK & DATA COMMUNICATION **Course Code : 316338**

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/106/105/106105082/	NPTEL Course on Data Communication
2	https://www.youtube.com/watch?v=O--rkQNKqls	NPTEL Course on Computer Networks and Internet Protocol
3	https://www.netacad.com/cisco-packet-tracer	Cisco Packet Tracer Software Simulator
4	https://onlinecourses.swayam2.ac.in/cec19_cs07/preview	Swayam course on Computer Networks
5	https://onlinecourses.nptel.ac.in/noc22_ee61/preview	NPTEL Course on Communication Networks
6	https://archive.nptel.ac.in/courses/106/105/106105081/	NPTEL Course on Computer Networks

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students