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DATA COMMUNICATION AND COMPUTER NETWORK   **Course Code : 314318**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Fourth**
Course Title	**: DATA COMMUNICATION AND COMPUTER NETWORK**
Course Code	**: 314318**

I. RATIONALE

Data communication and computer networks are essential components of modern computing infrastructure, enabling seamless exchange of information and facilitating collaboration across various devices and locations. By considering various applications, students should be able to choose, classify, install, troubleshoot, and maintain various data communication networks. This course provides the important concepts and techniques related to networking and offer students to have valuable insights into technology behind network communication.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified Outcome through various teaching learning experiences:
• Manage Data Communication and Computer Network

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Analyze the functioning of Data Communication and Computer Network.
- CO2 - Select relevant Transmission Media and Switching Techniques as per need.
- CO3 - Analyze the Transmission Errors with respect to IEEE standards.
- CO4 - Configure different TCP/IP services.
- CO5 - Implement relevant Network Topology using Networking Devices.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL			
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
314318	DATA COMMUNICATION AND COMPUTER NETWORK	DCN	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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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 Compare the characteristics of analog and digital signals on the given parameter. TLO 1.3 Explain the process of data communication using the given mode. TLO 1.4 Classify computer networks on the specified parameter.	**Unit - I Fundamentals of Data Communication and Computer Network** 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	Lecture Using Chalk-Board, Presentations, Video Demonstrations

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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 Explain with sketches the construction of a given type of cable. TLO 2.2 Explain with sketches the characteristics of the given type of unguided transmission media. TLO 2.3 Explain with sketches the working of the given Multiplexing technique. TLO 2.4 Describe with sketches the working principle of the given Switching technique. TLO 2.5 Compare different Switching techniques on the given parameter.	**Unit - II Transmission Media And Switching** 2.1 Communication Media: Guided Transmission Media Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable 2.2 Unguided Transmission Media: Radio Waves, Microwaves, Infrared, Satellite 2.3 Line-of-Sight Transmission, Point-to-Point, Broadcast 2.4 Multiplexing: Frequency-Division Multiplexing ,Time - Division Multiplexing 2.5 Switching: Circuit-switched network, Packet switched network	Lecture Using Chalk-Board, Presentations, Video Demonstrations
3	TLO 3.1 Explain working of the given error detection and correction method. TLO 3.2 Explain features of the given IEEE communication standard. TLO 3.3 Explain characteristics of the given layer in IEEE 802.11 architecture. TLO 3.4 Explain with sketches the process of creating a Bluetooth environment using the given architecture. TLO 3.5 Compare the specified generations of mobile telephone systems on the given parameter.	**Unit - III Error Detection and Correction** 3.1 Types of Errors, Forward Error Correction Versus Retransmission 3.2 Framing: Fixed Sized and Variable Sized Framing 3.3 Error Detection: Repetition codes, Parity bits, Checksums, CRC 3.4 Error Correction: Automatic Repeat Request (ARQ), Hamming Code 3.5 Wireless LAN IEEE 802.11 standard Architecture, Features of IEEE 802.11 versions: 802.11,802.11a,802.11b,802.11g,802.11n,802.11p 3.6 Bluetooth Architecture: Piconet, Scatternet 3.7 Mobile Generations: 3G, 4G and 5G	Lecture Using Chalk-Board, Presentations, Video Demonstrations, Flipped Classroom

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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 Identify functions and features of the given layer of OSI Reference model. TLO 4.2 Compare the specified service on the given parameters. TLO 4.3 Classify IP Addresses on the basis of its class from the given set of addresses. TLO 4.4 Distinguish between IPv4 and IPv6 on the given parameters. TLO 4.5 Describe with sketches the procedure to configure the given TCP/IP service.	**Unit - IV Network Communication Models** 4.1 THE OSI MODEL: Layered Architecture, Encapsulation 4.2 Layers in OSI Model(Functions of each layer)-Physical Layer,Data-Link Layer,Network Layer,Transport Layer,Session Layer,Presentation Layer,Application Layer 4.3 TCP/IP Layers and their functions: Host To Network Layer,Internet Layer,Transport Layer,Application Layer 4.4 Protocols: Host To Network Layer-SLIP,PPP, Internet Layer-IP,ARP,RARP,ICMP, Transport Layer-TCP and UDP, Application Layer-FTP,HTTP,SMTP,TELNET,BOOTP,DHCP 4.5 Addressing: Physical Address, Logical Address, Port Address 4.6 IP Address-Concept, Notation, Address Space 4.7 IPv4 Addressing: Classful and Classless Addressing ,subnet mask,supernetting,subnetting 4.8 IPV6 Addressing scheme and basic structure	Lecture Using Chalk-Board, Presentations, Case Study, Flipped Classroom
5	TLO 5.1 Compare different computing models on the given parameter. TLO 5.2 Identify relevant network topology for the given situation. TLO 5.3 Compare different topologies on the given parameter. TLO 5.4 Select network connecting device for the given situation. TLO 5.5 Describe with sketches the procedure to configure the given networking device.	**Unit - V Network Topologies And Network Devices** 5.1 Network Computing Model: Peer To Peer, Client Server 5.2 Network Topologies: Introduction, Definition, Selection criteria, Types of Topology- Star ,Mesh, Tree, Hybrid 5.3 Network Connecting Devices: Switch, Router, Repeater, Bridge, Gateways and Modem	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom

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 Implement Amplitude Shift Keying(ASK)	1	* Amplitude Shift Keying(ASK) using any simulator	2	CO1
LLO 2.1 Implement Frequency Shift Keying(FSK)	2	Frequency Shift Keying(FSK) using any simulator	2	CO1
LLO 3.1 Implement Phase Shift Keying(PSK)	3	Phase Shift Keying(PSK) using any open source simulation software	2	CO1
LLO 4.1 Create standard network straight cable by using cable tester.	4	*Create and Test standard straight network cable(Universal Colour Code) using crimping tool	2	CO2
LLO 5.1 Create standard Cross network cable by using cable tester.	5	Create and Test standard Cross network cable(Universal Colour Code) using crimping tool	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Use basic programming skills to simulate communication systems. LLO 6.2 Debug and execute the program for Time Division Multiplexing(TDM).	6	* Generate a Time Division Multiplexing(TDM) signal using relevant simulation software	2	CO2
LLO 7.1 Transfer data using Bluetooth.	7	*Create a Hybrid Network Using Bluetooth	2	CO3
LLO 8.1 Identify different error detection methods. LLO 8.2 Detect errors using Checksum.	8	*Locate the error bit in the given data string by applying checksum error detection method	2	CO3
LLO 9.1 create WI-FI environment.	9	*Implement Wireless network	2	CO3
LLO 10.1 Draw block diagram for parity check. LLO 10.2 Implement parity check with examples.	10	Write a 'C' program for parity check error detection	2	CO3
LLO 11.1 Implement C Program for CRC	11	*Write a 'C' program for Cyclic Redundancy Check(CRC) error detection	2	CO3
LLO 12.1 Implement Hamming code in any suitable programming language.	12	*Write a 'C' program for error correction using Hamming code	2	CO3
LLO 13.1 Use IP address and appropriate subnet mask for given problem statement.	13	*Configure static IP address in operating system along with appropriate subnet mask for given problem	2	CO4
LLO 14.1 Implement IP addresses for intranet in Class A, Class B, Class C.	14	* Implement Classful Address in a given network node i)Identify range of IP Address in various classes ii)Justify the reason to choose various IP address classes for creating given network	2	CO4
LLO 15.1 Troubleshoot computer network using commands.	15	*Execute TCP/IP network commands:ipconfig,ping,tracert	2	CO4
LLO 16.1 Troubleshoot computer network using commands.	16	*Execute TCP/IP network commands: netstat, pathping, route	2	CO4
LLO 17.1 Use wireshark packet sniffer software.	17	*1) Install Wireshark and configure as packet sniffer- i)Capture IP,TELNET, FTP packets using Wireshark	2	CO4
LLO 18.1 Measure various types of Delay by using Wireshark.	18	Capture TCP and UDP packet using Wireshark	2	CO4
LLO 19.1 Filter ARP and ICMP packet Traffic using Wireshark.	19	Capture ARP and ICMP packet Traffic using Wireshark	2	CO4
LLO 20.1 Install server operating system	20	Install Operating System Linux/Windows/Any other Server	2	CO4
LLO 21.1 Create FTP Server	21	Use FTP protocol to transfer file from one system to another system	2	CO4
LLO 22.1 Implement IPv6 addressing scheme on a network.	22	Create IPv6 environment in a small network using simulator	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 23.1 Configure HTTP server on given operating system.	23	*Create HTTP server	2	CO5
LLO 24.1 Use star topology for a given situation.	24	*Create computers using Star topology with wired media	2	CO5
LLO 25.1 Use Network simulator CISCO packet tracer.	25	Create Tree topology using CISCO packet tracer software	2	CO5
LLO 26.1 Implement remote login feature.	26	Configure TELNET for remote login	2	CO5
LLO 27.1 Survey existing network infrastructure.	27	*Visit your computer laboratory- i)Identify the type of topology ii)Identify types of connecting devices with specifications iii)Identify types of cables with specifications iv)List the type of network applications commonly used in the laboratory iv)Draw the layout of installed network	4	CO5
LLO 28.1 Transfer a file from one computer to another. LLO 28.2 Print documents from remote system in a network.	28	Share folder and printer in a network	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)

Assignment

- Solve an assignment on any relevant topic given by the Teacher
- For a trading firm an organization with 10users, draw network architecture design of wireless LAN.
- 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.

Micro project

- Install and configure NIC and find MAC Address of Device
- Design a network using any topology and do fault identification
- Create a tool that monitors network bandwidth usage in real-time

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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	Desktop Computer with basic configuration	All
2	Network Tool Kit: Crimping Tool for RJ-45 connector ,3in 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)	All
3	Network Accessories: RJ45 connector, UTP cable, optical fibre cable, Coaxial cable, various connectors,1000Mbps NIC	All
4	UPS 6 KVA online	All
5	Ethernet Switch- 4/8/16/24/32	All
6	Router-256MB Memory storage capacity, compatible with Desktop and Laptop, Rack Mountable, Wireless Connectivity	All
7	Printer	All
8	Wireshark(https://www.wireshark.org/download.html)or any other Packet Analyzer Tool	All
9	Simulation Software: CISCO Packet Tracer, CORE Network Emulator or Similar	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	10	4	8	4	16
2	II	Transmission Media And Switching	CO2	10	4	4	6	14
3	III	Error Detection and Correction	CO3	8	4	4	6	14
4	IV	Network Communication Models	CO4	12	4	6	8	18
5	V	Network Topologies And Network Devices	CO5	5	2	2	4	8
		Grand Total		**45**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- A continuous assessment based term work.

Summative Assessment (Assessment of Learning)

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- End semester examination, Lab performance, Viva-voce

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	1	-	2	1	-	-	1			
CO2	1	1	2	1	-	1	1			
CO3	1	2	1	1	-	-	1			
CO4	1	2	2	1	-	1	1			
CO5	-	2	2	1	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	Data Communication and Networks	McGraw Hill Education ISBN-10 9780071077705,ISBN-13 978-0071077705
5	Comer Douglas E.	TCP/IP Principles, Protocols and Architectures	PEARSON ISBN 10: 0-13-608530-X ISBN 13: 978-0-13-608530-0

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/	Data Communication-Definition, Components,Types,Channels
2	https://www.tutorialspoint.com/data_communication_computer_network/index.htm	Data Communication and Computer Network
3	https://nptel.ac.in/courses/106105081	Computer Networks
4	https://nptel.ac.in/courses/106105183	Computer Networks and Internet Protocol
5	Introduction To Computer Networks	Studytonight	Introduction To 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