CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT305	DATA COMMUNICATION AND NETWORKING	PCC	3	1	0	4

Preamble: The syllabus is prepared with a view to equip the Engineering Graduates to learn basic concepts in data communication and computer networking, and to fine-tune performance parameters used in data transmission.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Discuss the basic concepts used in data communication and computer networking	Level 2 :Understand
CO 2	Identify the concepts of data transmission and apply signal encoding techniques in data transmission.	Level 3 : Apply
CO 3	Compare different transmission mode, multiplexing, and Spread Spectrum techniques.	Level 2 :Understand
CO 4	Describe the design issues and protocols in data link layer.	Level 2 :Understand
CO 5	Summarize the routing algorithms and congestion control techniques in network layer.	Level 2 :Understand

Mapping of Course Outcomes with Program Outcomes 3/2/1: High/Medium/Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	-	-	-	-	-	-	2
CO 2	3	3	2	1	2	-	-	-	-	-	-	2
CO 3	2	3	1	2	2	-	-	-	-	-	-	2
CO 4	2	3	3	2	1	-	-	-	-	-	-	2
CO 5	2	2	2	1	1	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category Levels	Continuous Assessment Tests		End Semester Examination
	1	2	
BL 2: Understand	30	30	60
BL 3: Apply	20	20	40
BL 4: Analyse			
BL 5: Evaluate			
BL 6: Create			

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be *two* parts; **Part A** and **Part B**. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer *all* questions. Part B contains 2 questions from each module of which student should answer *any one*. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. List the various layers of the OSI reference model.
2. What are the types of topologies used in a network?
3. Mention the various devices used in different layers of the TCP/IP reference model.
4. Define a Protocol Data Unit (PDU).
5. Compare the features of different guided media used in data transmission.
6. Give a comparative analysis of different kinds of satellite communication.
7. Compare and contrast the functionalities of hubs, bridges and switches.

Course Outcome 2 (CO 2):

1. Explain the impairments in data transmission.
2. What is Nyquist criteria for channel bandwidth?
3. Differentiate between analog and digital signals used in transmission.
4. Explain the process of Delta Modulation?

Course Outcome 3 (CO 3):

1. Explain Spread Spectrum Techniques used in networks.
2. Compare and contrast FDM and WDM.
3. Explain CDMA with the help of an example
4. Differentiate statistical TDM and synchronous TDM
5. Discuss synchronous transmission. How is synchronization provided for synchronous transmission?

Course Outcome 4 (CO 4):

1. Assess the suitability of various error correcting codes to deal with single-bit and burst errors in data transmission.
2. Derive a Hamming code for single bit error correction (For a data of length 7 Bit).
3. How are errors detected using parity checking? What are the limitations of parity checking?
4. What are the services offered by the Data Link Layer? Mention the protocols also.
5. With the help of a diagram, explain the format of an Ethernet frame.

Course Outcome 5 (CO 5):

1. What are the functionalities of network layer?
2. Compare distance vector routing and link state routing?
3. What is count-to-infinity problem? How can it be solved?
4. Explain how congestion control is performed in network layer
5. Explain congestion control in virtual circuit subnet

Model Question Paper

Course Code: ITT305

Course Name: Data Communication and Networking

Max.Marks:100 Duration: 3 Hours

Part A

Answer all questions. Each question carries 3 marks. (10 * 3 = 30 Marks)

1. What are the features of WAN.
2. Explain the role of routers in Networks.
3. Explain Data rate, Noise and Bandwidth with respect to a channel.
4. If a periodic signal is decomposed into five sine waves with frequencies of 100, 300, 500, 700, and 900 Hz, what is its bandwidth? Draw the spectrum, assuming all components have a maximum amplitude of 10 V.
5. Draw the constellation diagrams for ASK, BPSK, and QPSK signals.
6. Define scrambling and give its purpose.
7. Using an example, explain two-dimensional parity checks.
8. Write a short note on CDMA.
9. Explain the significance of QoS in communication
10. Explain the importance of the age field in link state messages

Part B

Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)

11 List and explain the main features of all the seven layers of the ISO/OSI reference model and compare it with TCP/IP Model. 14

OR

12 a. Explain the features of any two guided transmission media 9

b. Describe the use of satellites in communication 5

13	a.	Explain the features of NRZ, AMI, and Manchester encoding schemes. Encode the given digital data 10110010 using NRZ-L, NRZ-I, AMI, Manchester and differential Manchester encoding schemes?	10
	b.	A telephone line normally has a bandwidth of 3000 Hz (300 to 3300 Hz) assigned for data communications. The signal-to-noise ratio is usually 3162. Find the channel capacity.	4
		OR	
14	a.	What are the transmission impairments happening in data communication?	10
	b.	Consider a channel with a 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level?	4
15	a.	Explain Multiplexing in detail.	10
	b.	List the features of frequency hopping spread spectrum.	4
		OR	
16	a.	Describe direct sequence spread spectrum in detail	10
	b.	Explain in detail about synchronous communication	4
17	a.	List and explain the sliding window protocols used in data link layer	10
	b.	Derive the saturation throughput of pure ALOHA	4
		OR	
18	a.	Describe about CRC encoding and decoding with data word 1010 with $G(x) = x^3+x+1$	10
	b.	What is CSMA/CA?	4
19	a.	Explain distance vector routing in detail	10
	b.	What is flooding?	4
		OR	
20	a	Explain in detail about the congestion control mechanisms used by datagram subnets	10
	b.	What are the services provided by the transport layer?	4

Syllabus

Module 1: Overview of Data Communication and Networks (8 Hours)
Introduction: - Types of Computer Networks, Network Software - Protocol Hierarchies, Connection oriented and Connection less hierarchies, Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model – Comparison of OSI and TCP/IP reference models. Physical Layer: - Guided Transmission Media– Twisted Pair, Coaxial and Fiber Optics, Wireless Transmission- Radio and Microwave transmission, Communication Satellites – GEO, MEO, LEO. Comparison of Network hardware - Repeaters, Routers, Bridges, Gateways, and Hub.
Module 2: Data Transmission and Encoding Techniques (10 Hours)
Data and signals, Analog Signals, Digital Signals - Transmission Impairments,Data Rate Limits: Channel Capacity, Nyquist Bit Rate, Shannon Capacity, Performance parameters - Bandwidth, Throughput, Delay & Jitter. Digital-To-Digital Conversion: Line Coding Schemes: Unipolar, Polar, Bipolar - Block Coding, Scrambling, Analog-To-Digital Conversion: Pulse Code Modulation, Delta Modulation - Digital-To-Analog Conversion: ASK, FSK, PSK.
Module 3: Digital Transmission (7 Hours)
Transmission Modes: Parallel and Serial Transmission, Asynchronous, Synchronous, Isochronous Transmission Multiplexing - TDM, FDM, WDM - Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access
Module 4:Link Layer Communication (10 Hours)
Data Link Layer – design issues - Error Detection: Parity Check, Checksum, CRC, Error Correction: Hamming code - Flow Control: Stop-and-Wait, Go-Back-N, and Selective-Repeat - Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing, Ethernet- Ethernet Cabling, Encoding, Frame Format, Binary Exponential Back Off Algorithm.
Module 5: Network Layer (10 Hours)
Network Layer Design Issues, Routing Algorithm – Optimality principle - Flooding - Distance vector routing – Link state routing –Multicast Routing - Congestion Control Algorithms – General principles – Congestion prevention policies – Choke packets – Random Early Detection- Quality of Service requirements- Buffering, Traffic shaping – Leaky bucket algorithm. Basic functions of Transport layer and Application layer (Basic understanding only).

Text Books

1. Andrew S. Tanenbaum, Computer Networks, Prentice Hall, 4th Edition, 2003
2. Behrouz A. Forouzan, Data Communications and Networking, 5/e, Tata McGraw Hill, 2017.
3. William Stallings, 'Data and Computer Communications', 8/e Pearson, 2007.

Reference Books

1. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring Internet, 6/e, Pearson Education, 2012.
4. L. L. Peterson and B. S. Davie, Computer Networks, A systems approach, 5/e, Morgan Kaufmann, 2011.

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Overview of Data Communication and Networks**	**8 Hours**
1.1	Introduction: - Types of Computer Networks, Network Software - Protocol Hierarchies, Connection oriented and Connection less hierarchies	2
1.2	Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model – Comparison of OSI and TCP/IP reference models	3
1.3	Physical Layer: - Guided Transmission Media– Twisted Pair, Coaxial and Fiber Optics, Wireless Transmission- Radio and Microwave transmission, Communication Satellites – GEO, MEO, LEO. Comparison of Network hardware - Repeaters, Routers, Bridges, Gateways, and Hub.	3
2	**Data Transmission and Encoding Techniques**	**10 Hours**
2.1	Data and signals, Analog Signals, Digital Signals - Transmission Impairments,Data Rate Limits: Channel Capacity, Nyquist Bit Rate, Shannon Capacity, Performance parameters - Bandwidth, Throughput, Delay & Jitter.	4
2.2	Digital-To-Digital Conversion: Line Coding Schemes: Unipolar, Polar, Bipolar - Block Coding, Scrambling,	3
2.3	Analog-To-Digital Conversion: Pulse Code Modulation, Delta Modulation - Digital-To-Analog Conversion: ASK, FSK, PSK.	3
3	**Digital Transmission**	**7 Hours**
3.1	Transmission Modes: Parallel and Serial Transmission, Asynchronous, Synchronous, Isochronous Transmission	2
3.2	Multiplexing - TDM, FDM, WDM	2
3.3	Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access	3
4	**Link Layer Communication**	**10 Hours**
4.1	Data Link Layer – design issues	2
4.2	Error Detection: Parity Check, Checksum, CRC, Error Correction: Hamming code	3

4.3	Flow Control: Stop-and-Wait, Go-Back-N, and Selective-Repeat	2
4.4	Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing, Ethernet- Ethernet Cabling, Encoding, Frame Format, Binary Exponential Back Off Algorithm.	3
5	**Network Layer**	**10 Hours**
5.1	Network Layer Design Issues, Routing Algorithm – Optimality principle - Flooding	2
5.2	Distance vector routing, Link state routing	2
5.3	Multicast Routing	1
5.4	Congestion Control Algorithms – General principles	1
5.5	Congestion prevention policies – Choke packets – Random Early Detection	2
5.6	Quality of Service requirements- Buffering, Traffic shaping – Leaky bucket algorithm.	1
5.7	Basic functions of Transport layer and Application layer	1