

CST 303	COMPUTER NETWORKS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

**Preamble:** Study of this course provides the learners a clear understanding of how computer networks from local area networks to the massive and global Internet are built, how they allow computers to share information and communicate with one another. This course covers the physical aspects of computer networks, layers of OSI Reference model, and inter-networking. The course helps the learners to compare and analyze the existing network technologies and choose a suitable network design for a given system.

**Prerequisite:** Nil

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

CO#	Course Outcomes
CO1	Explain the features of computer networks, protocols, and network design models ( <b>Cognitive Knowledge: Understand</b> )
CO2	Describe the fundamental characteristics of the physical layer and identify the usage in network communication ( <b>Cognitive Knowledge: Apply</b> )
CO3	Explain the design issues of data link layer, link layer protocols, bridges and switches ( <b>Cognitive Knowledge: Understand</b> )
CO4	Illustrate wired LAN protocols (IEEE 802.3) and wireless LAN protocols (IEEE 802.11) ( <b>Cognitive Knowledge: Understand</b> )
CO5	Select appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for a network ( <b>Cognitive Knowledge: Apply</b> )
CO6	Illustrate the functions and protocols of the network layer, transport layer, and application layer in inter-networking ( <b>Cognitive Knowledge: Understand</b> )

## Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓			✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

## Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	40	30	30

Understand	50	50	50
Apply	10	20	20
Analyze			
Evaluate			
Create			

**Mark Distribution**

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

**Continuous Internal Evaluation Pattern:**

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 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 a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module - 1 (Introduction and Physical Layer)

Introduction – Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.

Physical Layer – Modes of communication, Physical topologies, Signal encoding, Repeaters and hub, Transmission media overview. Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product.

### Module - 2 (Data Link Layer)

Data link layer - Data link layer design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11, Bridges & switches - Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

### Module - 3 (Network Layer)

Network layer design issues. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms. Quality of Service (QoS) - requirements, Techniques for achieving good QoS.

### Module - 4 (Network Layer in the Internet)

IP protocol, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP). Open Shortest Path First(OSPF) Protocol, Border Gateway Protocol (BGP), Internet multicasting, IPv6, ICMPv6.

### Module – 5 (Transport Layer and Application Layer)

Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment &release, Connection management modeling, TCP retransmission policy, TCP congestion control.

Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME), Simple Network Management Protocol

(SNMP), World Wide Web(WWW) – Architectural overview.

### **Text Books**

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).
2. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill

### **Reference Books**

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.
7. Request for Comments (RFC) Pages - IETF -<https://www.ietf.org/rfc.html>

### **Course Level Assessment Questions**

#### **Course Outcome1 (CO1)**

1. Compare TCP/IP and OSI reference model.
2. The purpose of physical layer is to transport a raw bit stream from one machine to another. Justify.

#### **Course Outcome2 (CO2)**

1. Write the physical and transmission characteristics of Optical Fibre Cable guided transmission media.
2. The distance between the sender and receiver systems is about 200 KM. The speed of transmission is 2GB/s. Find out the propagation time?

#### **Course Outcome3 (CO3)**

1. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?
2. What do you mean by bit stuffing?

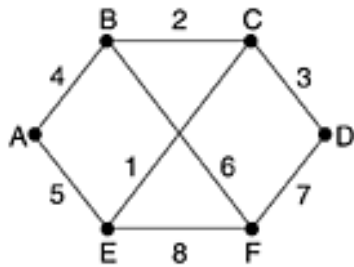
#### **Course Outcome4 (CO4)**

1. Draw and explain the frame format for Ethernet.
2. Give the differences between CSMA/CD and CSMA/CA protocol.

#### **Course Outcome5 (CO5)**

1. Consider the given subnet in which distance vector routing is used, and the vectors just come in to router C as follows: from B: (5, 0, 8, 12, 6, 2); from D: (16, 12, 6, 0, 9, 10);

and from E: (7, 6, 3, 9, 0, 4). The measured delays from C to B, D, and E, are 6, 3, and 5, respectively. What is C's new routing table? Give both the outgoing line to use and the expected delay.



2. Illustrate the leaky bucket congestion control technique.

### Course Outcome 6 (CO6)

1. How do you subnet the Class C IP Address 206.16.2.0 so as to have 30 subnets. What is the subnet mask for the maximum number of hosts? How many hosts can each subnet have?
2. Give the architecture of World Wide Web.

### Model Question Paper

QP CODE:

PAGES:

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST 303**

**Course Name : Computer Networks**

**Max Marks: 100**

**Duration: 3 Hours**

### PART-A

**(Answer All Questions. Each question carries 3 marks)**

1. What does "negotiation" mean when discussing network protocols in a layered architecture? Give an example.

2. Define simplex, half-duplex, and full-duplex transmission modes. Give one example for each.
3. Data link protocols almost always put the CRC in a trailer rather than in a header. Why?
4. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?
5. Illustrate the Count to Infinity problem in routing.
6. Describe two major differences between the warning bit method and the Random Early Detection (RED) method.
7. The Protocol field used in the IPv4 header is not present in the fixed IPv6 header. Why?
8. How many octets does the smallest possible IPv6 (IP version 6) datagram contain?
9. Can Transmission Control Protocol(TCP) be used directly over a network (e. g. an Ethernet) without using IP? Justify your answer.
10. When Web pages are sent out, they are prefixed by MIME headers. Why?

**(10x3=30)****Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) With a neat diagram, explain Open Systems Interconnection (OSI) Reference Model. **(8)**
- (b) Compare Twisted Pair, Coaxial Cable and Optical Fibre guided transmission media. **(6)**

**OR**

12. (a) Consider two networks providing reliable connection-oriented service. One of them offers a reliable byte stream and the other offers a reliable message stream. Are they identical? Justify your answer. **(8)**
- (b) Sketch the waveform in Manchester and Differential Manchester Encoding for the bitstream 11000110010. **(6)**



13. (a) A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is  $x^3 + 1$ . Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. (8)

- (b) Explain the working of High-Level Data Link Control (HDLC) protocol. (6)

**OR**

14. (a) Explain the working of IEEE 802.11 MAC sublayer. (10)

- (b) Distinguish between Bridges and Switches. (4)

15. (a) Illustrate Distance Vector Routing algorithm with an example. (8)

- (b) Explain the characteristics of Routing Information Protocol (RIP). (6)

**OR**

16. (a) A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps? (8)

- (b) Explain how routing is performed for mobile hosts. (6)

17. (a) Explain the address resolution problem using Address Resolution Protocol (ARP) and Reverse Address Resolution Protocol (RARP) with an example network. (10)

- (b) A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle? (4)

**OR**

18. (a) How do you subnet the Class C IP address 195.1.1.0 so as to have 10 subnets with a maximum of 12 hosts in each subnet. (6)

- (b) Draw IPv6 Datagram format and explain its features. (8)

19. (a) Distinguish the header formats of Transmission Control protocol (TCP) and User Datagram Protocol (UDP). (8)

- (b) Explain the principal Domain Name System (DNS) resource record types for (6)



IPv4.

**OR**

20. (a) What is the role of Simple Mail Transfer Protocol (SMTP) in E- mail? (6)
- (b) With the help of a basic model, explain the working of World Wide Web (WWW). (8)

**Teaching Plan**

No	Contents	No of Lecture Hrs
<b>Module – 1 (Introduction and Physical Layer) (10 hrs)</b>		
1.1	Introduction, Uses of computer networks.	1 hour
1.2	Network Hardware, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless networks, Home networks, Internetworks.	1 hour
1.3	Network Software, Protocol hierarchies, Design issues for the layers.	1 hour
1.4	Connection-oriented and Connectionless services, Service primitives, Relationship of services to protocols.	1 hour
1.5	Reference models, The OSI reference model.	1 hour
1.6	The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.	1 hour
1.7	Physical layer, Modes of communication, Simplex, Half-duplex, and Full-duplex, Physical topologies, Mesh, Star, Bus, Ring, Hybrid.	1 hour
1.8	Signal encoding, Manchester, Differential Manchester.	1 hour
1.9	Transmission media overview, Guided media (twisted pair, coaxial and fiber optic media), Unguided/wireless media (radio, microwave, and infrared).	1 hour
1.10	Performance indicators, Bandwidth (in Hertz and in Bits per Seconds),	1 hour

	Throughput, Latency (Delay), Queuing time, Bandwidth-Delay product.	
<b>Module 2 – (Data Link Layer) (10 hrs)</b>		
2.1	Data link layer design issues.	1 hour
2.2	Error detection and correction, Error correcting codes	1 hour
2.3	Error detecting codes.	1 hour
2.4	Sliding window protocols.	1 hour
2.5	High-Level Data Link Control(HDLC) protocol.	1 hour
2.6	Medium Access Control (MAC) sublayer, Channel allocation problem, Multiple access protocols.	1 hour
2.7	Ethernet, Ethernet cabling, Manchester encoding, Ethernet MAC sublayer protocol, Binary Exponential Backoff algorithm.	1 hour
2.8	Ethernet performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.2: Logical Link Control.	1 hour
2.9	Wireless LANs, 802.11 protocol stack, Physical layer, MAC Sublayer protocol, Frame structure.	1 hour
2.10	Bridges & switches, Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways.	1 hour
<b>Module 3 - (Network Layer) (8 hrs)</b>		
3.1	Network layer design issues.	1 hour
3.2	Routing algorithms, The Optimality Principle, Shortest path routing, Flooding.	1 hour
3.3	Distance Vector Routing.	1 hour
3.4	Link State Routing.	1 hour
3.5	Multicast routing, Routing for mobile hosts.	1 hour

3.6	General principles of congestion control, Congestion prevention policies, Congestion control in virtual circuit subnets.	1 hour
3.7	Congestion control algorithms, Congestion control in Datagram subnets, Load shedding, Jitter control.	1 hour
3.8	Quality of Service, Requirements, Techniques for achieving good Quality of Service.	1 hour
<b>Module 4 – (Network Layer in the Internet) (9 hrs)</b>		
4.1	Network layer in the Internet, Internet Protocol (IP).	1 hour
4.2	IP Addresses, Subnets, Classless Inter-Domain Routing (CIDR).	1 hour
4.3	IP Addresses, Network Address Translation (NAT).	1 hour
4.4	Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP).	1 hour
4.5	Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP).	1 hour
4.6	Open Shortest Path First (OSPF) protocol.	1 hour
4.7	Border Gateway Protocol (BGP).	1 hour
4.8	Internet multicasting.	1 hour
4.9	IPv6, Header format, Extension headers, Internet Control Message Protocol version 6 (ICMPv6).	1 hour
<b>Module 5 - ( Transport Layer and Application Layer) (8 hrs)</b>		
5.1	Transport Service, Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP).	1 hour
5.2	Transmission Control Protocol (TCP), TCP segment header, Connection establishment & release, Connection management modeling.	1 hour
5.3	TCP retransmission policy, TCP congestion control.	1 hour
5.4	Application layer, File Transfer Protocol (FTP).	1 hour

5.5	Domain Name System (DNS).	1 hour
5.6	Electronic Mail, Multipurpose Internet Mail Extension (MIME).	1 hour
5.7	Simple Network Management Protocol (SNMP).	1 hour
5.8	World Wide Web, Architectural overview.	1 hour

