B.E. COMPUTER SCIENCE & ENGINEERING 3RD YEAR 1st SEMESTER EXAM- 2025
COMPUTER NETWORKS

Time: 3 hours Full Marks: 100

Group A (Total Marks: 10) [CO1]
Answer Question No. 1 OR Question No. 2

1. How data is packed at different layers of the TCP/IP protocol stack? Explain with the frame structure of IEEE 802.3. Why has Ethernet imposed restrictions on both the minimum and maximum length of a frame? What do you mean by vulnerable time in multiple access protocol? Why does the vulnerable time in ALOHA depend on the average time required to send out a frame and CSMA depends on the maximum propagation time? Consider a pure ALOHA network of 100 stations that transmits 100 bits frames on a shared channel of 100Kbps. How many frames have to be sent by a station so that 1.35 frames will be sent successfully in 10 seconds?

2+2+2+2+2=10

OR

2. Describe how the Poisson process is used to model the transmission attempts of frames in ALOHA. Derive the maximum channel utilization and analyse the main reason for performance difference of pure ALOHA and Slotted ALOHA.
Suppose S={S1, S2, S3, .., Sn} is that set of stations in a pure ALOHA network. Let the stations be separated in such a way that the distance between two stations Si$\in$[1,2,...,n] and Sj$\in$[1,2,...,n] is ixj meter, where i$\neq$j. If m is the number of unsuccessful attempts for a particular frame, then formulate the possible backoff time. You can assume that the propagation speed of the signal is k meter/second. In this environment every node will try to send their frames in every time slot with probability p. What will be the probability that only one node transmits in a particular time slot?

3+3+(2+2)=10

Group B (Total Marks: 30) [CO2]
Answer Question No. 3 OR Question No. 4 AND Question No. 5 (Compulsory)

3. a) For conventional 10-Mbps Ethernet, why is the slot time set to 512-bit? Explain for the following two scenarios: (i) when the sender sends a minimum size packet of 512 bits (ii) when the sender sends a frame larger than the minimum size. What is the relationship between slot time and maximum network length? Explain the role of slot time in full duplex Ethernet.
b) Consider a 10 Mbps Ethernet LAN that has stations attached to a 2.5 km long coaxial cable. Given that the transmission speed is 2.3 x 108 m/sec, the packet size is 128 bytes out of which 30 bytes are overhead, find the (i) transmission delay (ii) propagation delay (iii) efficiency (iv) effective transmission rate and (v) maximum rate at which the network can send data.
c) Assume A and B are the only two stations on the above mentioned Ethernet. Each has a steady queue of frames to send. Both A and B attempt to transmit a frame, collide, and

A wins the first backoff race. At the end of this successful transmission by A, both A and B attempt to transmit and collide. Find the probability that A wins the second backoff race. Explain the scenario for the next two backoff races for both A and B.

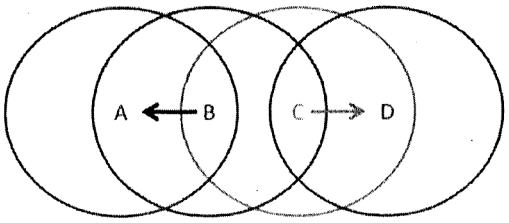
5+5+5=15

OR

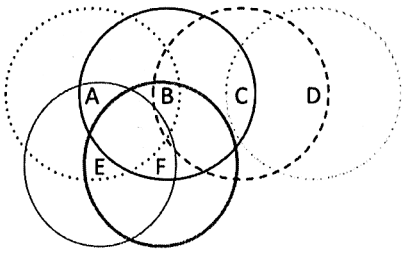
4. a) Sketch and describe the operation of a LAN bridge from 802.11 to 802.3.
b) A 1-km-long, 10-Mbps CSMA/CD (Carrier Sense Multiple Access with Collision Detection) LAN has a propagation speed of 200 m/μsec. Repeaters are not allowed in this system. Data frames are 256 bits long, including 32 bits of header, checksum, and other overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel in order to send a 32-bit acknowledgement frame. Explain different phases to complete this transmission. What is the effective data rate, excluding overhead, assuming that there are no collisions?
c) Show the Walsh table for a network consisting of 10 nodes. Prove the second property and third property of orthogonal sequences for the above CDMA network. How is CDMA superior to FDMA and TDMA? Explain with a suitable example.

4+4+(2+2+3)=15

5. a) Consider the following scenario: Assume, node B is sending to node A, and node C wants to send to node D. As, node C receives packets from node B, carrier sense would prevent it from sending to node D, even though it wouldn't interfere. Explain with a proper sketch how this problem can be solved.



Now, consider the figure below, list the potential hidden terminals and exposed terminals: i) when node A transmits to node B ii) when node B transmits to node C.

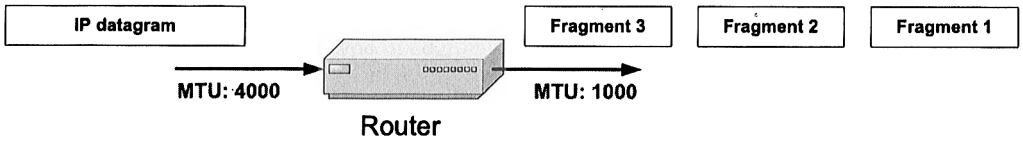


b) Describe the layered architecture of Bluetooth in respect to core protocols. How do masters and slaves within a piconet avoid bad channels? What are the different types of a frame in the baseband layer of Bluetooth? Explain the purpose of F, A and S subfields of header of a Bluetooth frame.

(3+2) +(3+2+2+3)=15

Group C (Total Marks: 30) [CO3]
Answer Question No. 6 (Compulsory) and Question No. 7 OR Question No. 8

6. Consider the following networking environment. A datagram (identification: 0xa123) with size 2400 bytes must be fragmented according to an MTU limit of 1000 bytes according to the following figure.
i) Which fields in the IP header are involved in fragmentation? Explain with a schematic diagram of IP header format. ii) Determine the maximum payload length. iii) Determine the offset of the fragments. iv) Mention the D and M flags of each fragment v) What is the minimum payload length here? vi) Find the total length of three fragments.



3+2+4+2+2+2=15

7. a) Suppose five engineering departments of our University need 110, 45, 28, 14 and 12 IP addresses. A class-C network address 198.131.172.0 has been allotted to the institute. Suggest the appropriate subnetting scheme and derive the appropriate subnet marks for each department. Also provide the starting and ending address of each department.
b) Explain how a router finds the network address to route the packet in following three cases: i) A router outside the department of CSE receives a packet with destination address 190.240.7.91 ii) A router inside the department of CSE receives the same packet with destination address 190.240.33.91. iii) Discuss what happens if this destination does not exist in these two cases.
c) In the present scenario, shortage of addresses is a serious problem. Discuss a solution to address this problem (explain with suitable example)?

4+(3+3+2)+3=15

OR

8. Explain when the following issues occur and how they are addressed by the network layer i) destination unreachable ii) source quench and iii) redirection. Explain how DHCP dynamically assigns IP addresses with suitable interaction diagrams. Discuss the instability issue of distance vector routing with a suitable example. What strategies can be used to solve the two-node and three node loop instability issues?

3+6+3+3=15

Group D (Total Marks: 30) [CO4 and CO5]
Answer Question No. 9 OR Question No 10 and Question No 11 OR Question No. 12

9. a) Discuss the role of TCP in providing reliable data transfer. Explain the mechanisms used by TCP to ensure data integrity and order.
b) Explain the Three-Way Handshake process in TCP connection establishment. Include a suitable schematic diagram and an example of communication between a client and a server.

c) Two TCP segments are transmitted between a client and a server (Note: Each segment has a payload of 500 bytes.). The headers of the segments are as follows:
Segment 1 Header (Hexadecimal):
0035 1F90 0045 6789 0000 0001 6012 0020 1234 ABCD
Segment 2 Header (Hexadecimal):
1F90 0035 0045 6799 0000 0011 6018 0040 5678 DEFA
Answer the following questions:
(i) Identify the client and server based on the port numbers. Which application protocol is likely being used? (ii) Verify if Segment 2 is the acknowledgment for Segment 1. (iii) Compute the transmission rate if Segment 1 is transmitted over a link of 1 Gbps. (iv) What is the next expected sequence number after Segment 1? (v) How does the window size change between the two segments? What is the implication of this change? (vi) What does the value of the PSH flag in Segment 2 indicate? (vii) What is the total size of Segment 2? (viii) What type of segments are these two? Provide justification.

3 + 4 + 8= 15

OR

10. a) Describe the structure of a socket header. Explain the importance of the checksum in UDP and how it is calculated. Discuss scenarios where the checksum field might be disabled.
b) How does the lack of a sequence number impact UDP communication compared to TCP?
c) Two UDP datagrams are captured during a network packet analysis session. The details of their headers are as follows:
Datagram 1 (in Hex): 1388 1F40 0020 9ABC
Datagram 2 (in Hex): 1F40 1388 0030 5DEF
Answer the following questions:
(i) Compare the source and destination ports of both datagrams. What can you infer about the communication flow? (ii) Discuss which of the two datagrams could belong to a server response in a client-server model, providing justification. (iii) Convert the length field of both datagrams to decimal and calculate the payload size for each. (iv) If Datagram 1's payload contains the message "Hello UDP," how many bytes of additional padding does it contain? (v) Compare the efficiency of data transmission for both datagrams at the UDP level.

6 + 4 + 5 = 15

11. Explain the architecture of e-mail in respect to SMTP, POP3 and IMAP4 and HTTP. Write the pseudo code for DNS implementation using Socket and justify your choice of socket. 5+10=15

OR

12. How are control and data characters distinguished in NVT? What is the difference between local and remote login in TELNET? Write the pseudo code for FTP implementation using Socket so that it can justify your explanation.

3+2+10=15