Indian Institute of Engineering Science and Technology, Shibpur
B.Tech 6th Semester (CST) Examination 2019
Under 5-year Dual-Degree (B. Tech-M. Tech) Programme

Computer Network and Distributed Systems   CS-602

Full marks: 70   Time: 3 hours

*Attempt **mandatory question 1** and **any 4** from the rest*
All parts of the same question must be answered together

1. Answer **all** questions (**a** to **e**). Total marks 30.

(a) Determine the maximum length of the cable (in km) for transmitting data at a rate of 500 Mbps in an Ethernet LAN with frames of size 10,000 bits. Assume that the signal speed in the cable to be 2,00,000 km/s.

[4]

(b) Two stations in the network use two-dimensional even parity scheme for the purpose of error detection purpose. The bit sequence of a received frame at the Rx station is as follows:
        1 1 0 0 1 0 1 0 0 0 1 1 0 0 1 1 1 0 0 0 1 0 0 0 1 1 1 0 1 0 1 1 1 0 0 1 0 0 1 0

Specify the actual information bits (information without parity bits) sent by the transmitting station. Assume that no error occurred in the actual information part. Is this frame going to be accepted by the receiver? Explain with justification.

[5]

(c) Five hosts A, B, C, D and E are connected to a layer-2 switch. Assume that the switch does not know anything about any of the hosts initially (empty lookup table). The first few frames are transmitted in the given order:
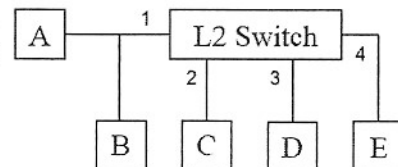

(i) A → C, (ii) A → B, (iii) C → A, (iv) E → B, (v) E → C, (vi) B → D, (vii) D → A and (viii) C → D

Which of these frames are broadcast by the L2-switch and which frames are unicast? Answer with brief justification.

[7]

(d) A five node autonomous system (AS) is shown using the following graph, where routers are represented by the nodes of the graph. The cost of individual link between the routers is mentioned in the graph itself. The *Distance Vector Routing* (DVR) protocol is used for as the intra-AS routing and each router shares DVR packet periodically. Answer the following questions:
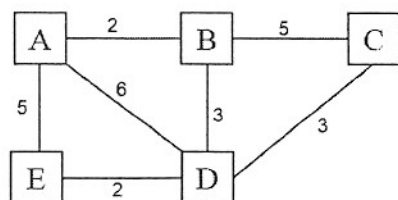
(i) Assuming all the routers are initialized, mention *initial distance vector* of every router after neighbor discovery procedure.
(ii) Also assume that the algorithm is applied one node at a time and announces *distance vector (DV)* to their neighbors. If order of exchange of DV is at first from A, then from B, then from C, and then from D. Mention routing table of every routers at the end of DV exchange from D.

[3+5]

(e) A host S needs to send a message consisting of 7 packets to host R using a sliding window and Selective-Repeat/Reject ARQ error control strategy, with window size set to 3. Note that all packets are ready and immediately available for transmission.

(i) Illustrate the data packets transmitted by S and the acknowledgements transmitted by R for sending the entire message, assuming no data packet or acknowledgement gets lost.
(ii) Now consider that every 4th packet that S transmits gets lost, but no acknowledgements from R ever get lost. Illustrate the process in this modified scenario.

[3+3]

2. (a) What is TCP-pseudo header?

(b) A router in an IP network has the following routing table:

Subnet Number	Subnet Mask	Next Hop
140.25.176.0	255.255.240.0	eth1
140.25.128.0	255.255.192.0	R2
140.25.192.0	255.255.192.0	R3
204.97.0.0	255.255.192.0	R4
Default	0.0.0.0	R1

Find the next hop for packets having the following destination IP addresses (with justification):
(i) 140.25.223.67   (ii) 204.97.16.234   (iii) 140.25.181.98   (iv) 204.97.130.186

[2+8]

3. (a) What is *silly window syndrome* in TCP?

(b) Two hosts are connected in an Ethernet LAN and runs some TCP application in a client-server model. The client connects to the server over a TCP connection. The initial sequence number at the site is 2375. The client opens the connection, sends 4000 bytes of data and closes the connection. What is the value of the sequence number in each of the following segments sent by the client? Explain with justifications. Assume that server has large enough receive buffer and there is no packet drop in the network.

(i) The SYN segments, (ii) The data segment(s), (iii) The FIN segments

[3+7]

4. (a) What are the differences between directed broadcast and local broadcast?

(b) An ISP is granted the block 60.70.80.0/25 IPv4 address. The ISP needs to allocate address among three organizations, Org-1, Org-2 and Org-3 with 58, 26 and 30 number of IP addresses respectively. For every organization, find the following –
(i) Network Id, (ii) Netmask, (iii) Range of IP addresses (iv) Directed broadcast IP address

[3+7]

5. (a) What is two-node instability (or two-node loop) problem in the context of Distance Vector Routing (DVR) protocol?

(b) Consider following graph as a network consists of 7 routers. Use *Dijkstra's* algorithm to find shortest path tree and the forwarding table only for node **A**.

Mention step-by-step procedure.
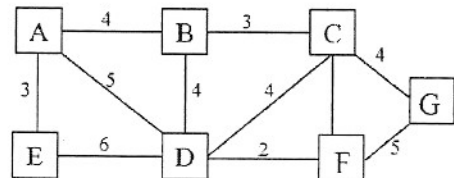
[3+7]

6. An IP datagram has arrived and following is the initial few bytes of the header (in hexadecimal)
45 00 00 F5 63 A8 20 96 04 06 7D 58 . . .

Answer following questions with brief justification:
(i)   What is the header size?
(ii)   Are there any *options* bytes in the packet?
(iii) What is the size of network layer payload?
(iv)   What is the transport layer protocol used?
(v)   Is the packet fragmented?
(vi)   How many more routers can the packet travel to?
(vii) Do you have any other important observations?

[10]

7. Write short note on **any 2** from the following:
(a) Orthogonal Variable Spreading Factor (OVSF)
(b) Internet Control Message Protocol (ICMP)
(c) Virtual-circuit Network

[5x2]