Indian Statistical Institute
Semester Examination: 2018
Course Name: M. Tech in Computer Science I.year
Subject Name: Computer Networks

Date: 27-04-2018 Maximum Marks: 110 Duration: 3 hours

Instructions:

You **may** attempt **all** questions which carry a total of **110** marks. However, the maximum marks you can score is only **100**.

1. (a) Consider a situation with eight parallel sessions using a 45 Mbps line. Each session generates Poisson traffic with $\lambda_i = 20$ packets/sec. Packet lengths are exponentially distributed with a mean of 8000 bits. There are two design choices:
   i. Each session is given a dedicated $\frac{45}{8}$ Mbps channel (via FDM or TDM).
   ii. Packets of all sessions compete for a single 45 Mbps shared channel.

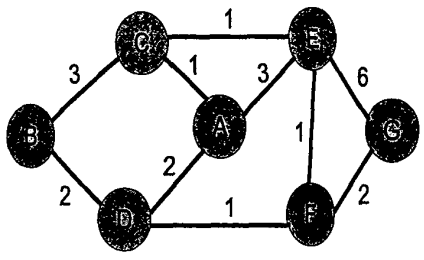
   Which choice is better with respect to average network delay? Explain you choice briefly. [8]

   (b) In CDMA/CD with a data rate of 10 Mbps, the maximum distance between any station pair is found to be 2500 m for correct operation of the collision detection process. What should be the maximum distance if we increase the data rate to 100 Mbps? [4]

   (c) Sixteen stations, numbered 1 through 16, are contending for the use of a shared channel by using the adaptive tree walk protocol. If stations 2, 3, 5, 9, 12, 14 suddenly become ready at once, compute how many bit slots are needed to resolve the contention. [6]

   (d) What problems would occur when CSMA is used in a wireless LAN? Describe the approaches that would solve the above problems. [2+8=10]

2. (a) Consider the network shown in the figure below. Using distance vector routing:
   i. Show the data that node A will receive in the first iteration of the algorithm.
   ii. Show the routing table for node A after the first iteration of the algorithm has been completed. [4+4=8]



   (b) What is Reverse Path Forwarding and how does it work? [8]

   (c) Suppose that all of the network sources are bursty-that they only occasionally have data to send. Would packet-switching or circuit switching be more desirable in this case? Justify your answer. [4]

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(d) Consider a token bucket rate controller, used to control a reserved rate flow. Assume that the token bucket has a capacity of 10 tokens and a token fill rate of 100 tokens per second, and that every packet consumes one token. If no token is available for an arriving packet, it is *marked* for possible discarding. Suppose that at time 0, the token bucket is empty and the next token arrives at time 10 msec. If packets $P_1, P_2, P_3, P_4, P_5, P_6$ arrive at times 11, 13, 17, 19, 23 and 29 msec respectively,

i. Which packets (if any) are marked?

ii. How many tokens are in the token bucket at time 55 msec if no additional packets arrive?

iii. How many tokens are in the token bucket at time 195 msec?

iv. What is the largest number of packets that can be sent between time 201 msec and time 299 msec without any of the packets being marked? [3+3+3+3=12]

3. (a) Indicate whether each of the following subnet masks are valid or invalid. Justify your answer.

i. 255.255.32.0

ii. 255.255.224.0 [4+4=8]

(b) For the IP address 188.15.110.8/24, determine

i. the subnet address,

ii. directed broadcast address for the subnet,

iii. maximum number of hosts on that subnet, and

iv. maximum number of subnets, if the same subnet mask is used for all the subnets in the network. [2+2+2+2=8]

(c) Aggregate the following four /24 IP addresses to the highest degree possible.

i. 212.56.132.0/24

ii. 212.56.133.0/24

iii. 212.56.134.0/24

iv. 212.56.135.0/24 [4]

(d) A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organizations, A, B, C and D request 4000, 2000, 4000, and 8000 addresses, respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation. [8]

4. (a) If the TCP round-trip time, RTT, is currently 30 msec and the following acknowledgements come in after 26, 32, and 24 msec, respectively, what is the new RTT estimate? Assume smoothing factor $\alpha = 0.9$. [6]

(b) At some point of time, a TCP connection is in slow-start phase with a congestion window of 4000 bytes. The maximum segment size used by the connection is 1000 bytes. What is the congestion window after it sends out 4 packets and receives ACKs for all of them before timeouts? [4]

(c) Why TCP and UDP use port numbers instead of using process IDs to identify the destination entity when delivering a message? [4]

(d) What is RPC and how does it work? [8]