BACHELOR OF COMPUTER SCIENCE. & ENGINEERING EXAMINATION, 2016

(3^{rd} year, 2nd Semester)

COMPUTER NETWORKS

Time: 3 hours

Full Marks: 100

Answer any FIVE questions.
(Parts of a question must be answered together)

1. a) Frames generated by different stations on a multiple access channel follow Poisson distribution with a mean generation rate of λ. The probability $P_n(t)$ of n frames being generated (all stations taken together) during an interval of length t is give by Poisson's law:

$$P_n(t) = [\ (\lambda t)^n / n!]\ e^{-\lambda t}$$

Use this law (if necessary) and show that when Slotted ALOHA protocol is used on this channel, the maximum possible channel utilisation is about 36.8%. Derive all relations that you use and explain all assumptions made.

b) Measurements on a slotted ALOHA channel with a very large number of users show that 10% of the slots are idle;
   i) What is the channel load G?
   ii) What is the channel throughput?

c) A large population ALOHA users manage to generate 50 requests/ second, including both originals and retransmissions. Time is slotted in units of 40 milliseconds
   i) What is the chance of success on first attempt?
   ii) What is the expected number of transmission attempts needed to succeed?

(8 + (3 +3) + (3 + 3))

2. a) Write down the 802.11 frame format and explain in details with special emphasis on the portion that deals with 'Frame Control'

b) List and briefly explain the different services that must be provided by a wireless LAN operating under 802.11 protocol

c) 802.3 protocol does not allow frames to be fragmented but 802.11 does; why? How are frame fragments managed by the later protocol?

[(4+4)+6+(3+3)]

3. a) Frames of 1000 bits are sent over a 1Mbps channel using a geostationary satellite whose propagation time from earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three bit sequence numbers are used. What is the maximum achievable channel utilization for the following protocols
   i) Stop and Wait
   ii) Go Back N
   iii) Selective Repeat

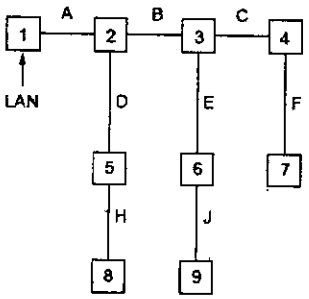
b) If 0 to MAX-SEQ is the range of sequence numbers used to identify frames, then
   i) What is the sender's window size in case of Go-Back-N sliding window protocol?
   ii) What is the sender's window size in case of Selective-Repeat sliding window protocol?
   iii) Explain in details the similarity or difference (as the case may be) of your answers to (i) & (ii) above

c) Explain Datagram subnet, Virtual Circuit subnet & IPv4 subnet.

[(2 + 2 + 2) + (2 + 2 + 4) + (2 + 2 + 2)]

4. a) Discuss briefly the similarities and differences between 802.11 & 802.16 protocols. Describe briefly the four service classes offered by 802.16.

b) Consider the spanning tree representation of interconnected LANs (1 to 9) shown below. Hosts a & b are on LAN1, c on LAN2 and d on LAN8. Initially, hash tables in all bridges are empty.



Show how the hash tables of different bridges change after each of the following events happen in sequence, ie., first i), then ii), and so on:
i) **a** sends to **d** ii) **c** sends to **a** iii) **d** sends to **c** iv) **d** moved to LAN6 v) **d** sends to **a**

c) A router is generating IPv4 packets whose total length (data plus header) is 1024 bytes. Assuming that packets have 'time to live' of 10 seconds, what is the maximum line speed at which the router can operate without risk of cycling through the IP datagram ID number space? Explain your answer briefly. **[(4+6)+7+3]**

5. a) Briefly describe the Leaky Bucket technique. Give a possible implementation for a Leaky Bucket that handles variable sized packets.

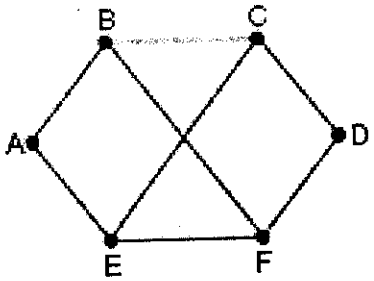
b) Consider a flow specification that has a maximum packet size of 1000 bytes, a token bucket rate of 10 million bytes/ sec, a token bucket size of 1 million bytes and a maximum transmission rate of 50 million bytes/ sec. How long can a burst at maximum speed last? Explain your answer and derive any relation that you use.

c) How are 'choke' packets different from 'flow control' packets? **[(5+4)+6+5]**

6. a) Consider the subnet given in next page. Distance vector routing is being used and the following vectors have just come in to router C:

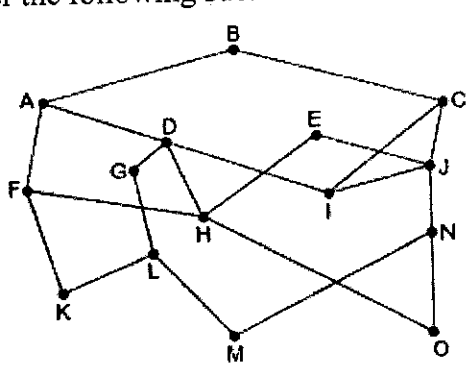
From B	(5, 0, 8, 12, 6, 2)
From D	(16, 12, 6, 0, 9, 10)
From E	(7, 6, 3, 9, 0, 4)

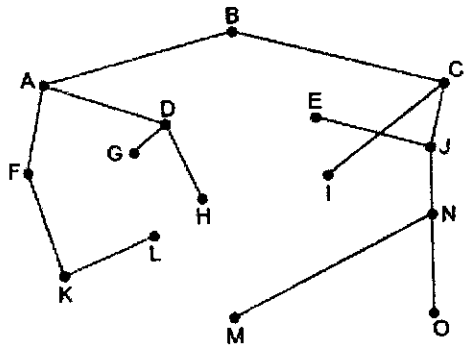
Measured delays from C to B, D and E are 6, 3 and 5 respectively.



What is C's new routing table? Give both the outgoing line to use and the expected delay. Explain your answer briefly.

b) Consider the following subnet and the corresponding 'sink-tree' for router B:





i) Illustrate the 'Reverse Path Forwarding' technique for broadcasting from router B. How many packets are generated? Explain your answer properly.
ii) If all routers are assumed to be aware of the 'Sink-Tree' for B, how many packets will be generated to complete the broadcast? Explain briefly.
iii) If all links have uniform bandwidth of 50 Kbps, and packet to be broadcast is 1000 bits long, how long will it take for the broadcast to be completed in (i) & in (ii) above? **[7 + (6 + 3 + (2 + 2))]**

7. a) A company with 40 departments is assigned class B address 130.50.0.0. Each department needs a separate subnet. Design the subnets and list the start & end addresses for the first three departments. Specify the mask in p.q.r.s/ m notation. Also explain how a packet is routed to destination host 130.50.15.6.

b) A large number of consecutive IP addresses are available starting from 194.24.0.0. Three organizations A, B and C request for 2000, 4000 and 1000 addresses, respectively, in that order. For each of these, give the first & last IP addresses assigned and the mask in p.q.r.s/ m notation. Avoid unnecessary address space fragmentation. Also explain how a packet is routed to destination host 194.24.17.4. **[(6+4)+(6+4)]**

8. Write short notes on any four:
i) IPv6 ii) Ethernet iii) Link-State routing iv) Multicast routing
v) Traffic shaping vi) WDMA vii) Router & Switch viii) TCP & UDP
[4 × 5]