BACHELOR OF COMPUTER SCIENCE. & ENGINEERING EXAMINATION, 2012

(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) Represent a M/M/1 queue as a Markov birth & death process and hence show that the mean queue length N is give by:

$$N = \rho / (1 - \rho)$$

where $\rho = \lambda/\mu$; ρ, λ & μ have their usual meanings.

b) A node in a network is very fast and needs negligible time to process incoming frames. The channel connecting this node has a bandwidth of C bits/second. Frames arrive (Poisson distribution) with a mean rate of λ frames/second. Frame length distribution has an exponential probability density function with a mean of $1/\mu$ bits/frame. Show that the mean waiting time T is given by:

$$T = 1 / (\mu C - \lambda)$$

c) Frames arrive at a 100 Mbps channel for onward transmission. If channel is busy when a frame arrives, it waits its turn in a queue. Frame length is exponentially distributed with a mean of 10,000 bits/frame. For each of the frame arrival rates, find delay experienced by the average frame, including both queueing time and transmission time.

i) 90 frames/ second
ii) 900 frames/ second
iii) 9000 frames/ second **(8 + 6 + 2×3)**

2. 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))

3. a) Give the algorithm for 'Selective Repeat' sliding window protocol and explain its working in details.

   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) What is a 'NAK'? Why and where is it used? **((6 + 4) + (2 + 2 + 4) + 2)**

4. a) An earth station is sending a stream of 1000 bytes frames to another earth station through a 100 Kbps satellite channel. Earth to satellite propagation delay is 270 milliseconds. Delay from satellite to earth is also the same. The receiving station takes 10 milliseconds to process each incoming frame and then sends back a 500 bytes 'Ack' frame. Assume that the satellite has zero retransmission delay. What should be the sender's window size (for optimum channel utilization) if 'Go –Back-N' protocol is being used? Explain your answer briefly.

   b) Stations 2, 4, 5 & 6 are competing for a multi-access channel using the Binary-Countdown method. Enumerate the different steps and find the minimum number of bidding rounds necessary for all the stations to gain access to the channel.

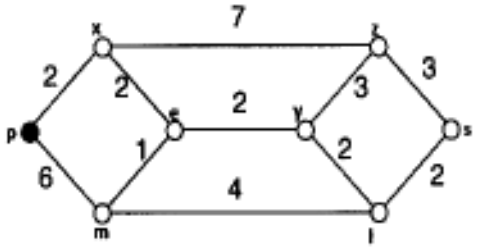
   c) How long does a station 's' have to wait, in the worst case, before it can start transmitting its frame over an Ethernet LAN that uses
      i) The basic Bit-Map protocol?
      ii) The Mok and Ward's protocol with permuting virtual station numbers?
      (7 + 7 + (2 + 4))

5. 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 the 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) + 7 + (2 + 3))**

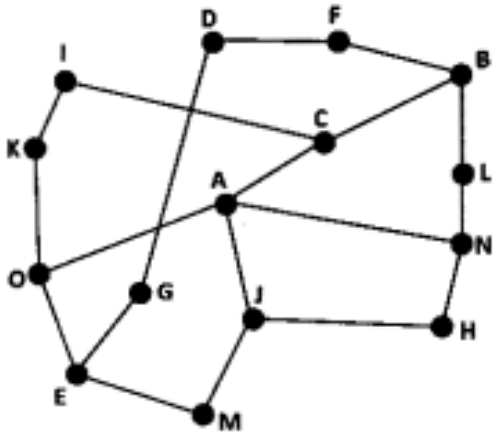
6. a) Consider the subnet given below:



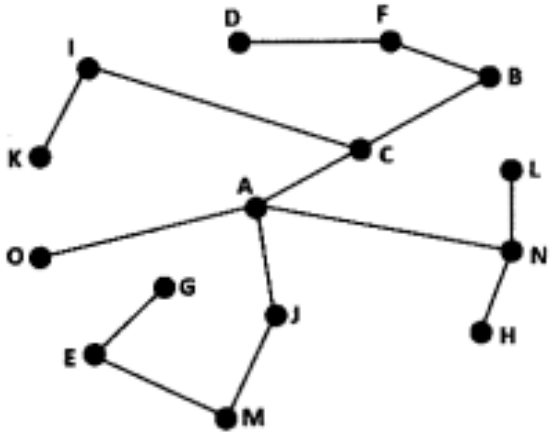
   Give details of all steps necessary to compute the shortest path(s) from node 'p' to node 's' using Dijkstra's Shortest Path algorithm. Explain your steps (with diagrams, if

necessary) in details.

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



The Subnet



Sink Tree for node A

i) Illustrate the 'Reverse Path Forwarding' technique for broadcasting from router A. How many packets are generated? Explain your answer properly.
ii) If all routers are assumed to be aware of the 'Sink-Tree' for A, 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) Give the different 'Classfull' address formats as used under IPv4 and explain each briefly.

b) A large number of consecutive IP addresses are available starting at 198.16.0.0. Four organisations A, B, C and D request for 4000, 2000, 4000 and 8000 addresses respectively ,and in that order. For each of the organisation give the first IP address assigned and the last IP address assigned as well as the mask in w.x.y.z/s notation.

c) How does IPv4
i) Deal with fragmented packets?
ii) Ensure that certain packets are never fragmented?
iii) Route certain packets through pre-specified routers? **(7 + 7 + (2 × 3))**

8. Write short notes on any four:
i) DCF & PCF in wireless network
ii) WDMA
iii) Link-State routing
iv) Multicast routing
v) Protocol modeling using 'Finite State Machine'
vi) Adaptive Tree walk protocol
vii) Routing techniques for Bridges
viii) CIDR **(4 × 5)**