BACHELOR OF COMPUTER SCIENCE. & ENGINEERING EXAMINATION, 2015

(3rd 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 $\rho = \lambda/\mu$; $\rho$, $\lambda$ & $\mu$ 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 $\lambda$ 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 **(8 + 6 + 3×2)**

2. a) A client process wishes to avail of a reliable byte-stream oriented service from a server process. The primitives available to the processes are

LISTEN
CONNECT
RECEIVE
SEND
DISCONNECT

The primitives have the usual meaning. Explain in details (in an itemized manner), how a connection is setup, utilized and finally dismantled. Also indicate clearly, the services provided by the protocol implementing software and those provided by the underlying O.S.

b) Make an approximate performance analysis of the Ethernet under condition of constant heavy load, i.e., k stations always ready to transmit, and hence show that channel efficiency is given by

**1/(1+2BLe/CF)**

Where F: frame length, B: network bandwidth, L: cable length, C: signal speed in cable
Assume the optimal case of e contention slots per frame

c) Briefly describe the 'Binary Exponential Backoff' algorithm as applied to CSMA/CD. **(8+4)+4+4**

3. a) Briefly discuss the basic idea(s) behind the Open – Loop & Closed – Loop classification of techniques used to manage congestion in a network.

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

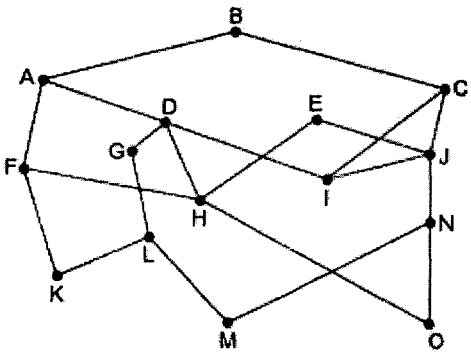
c) Consider the following flow specification:

| | |
|---|---|
| Maximum packet size: | 1000 bytes |
| Token bucket filling rate: | 10 million bytes/second |
| Token bucket size: | 1 million bytes |
| Maximum transmission rate: | 50 million bytes/second |

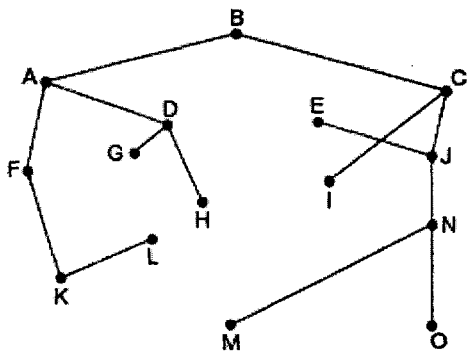
How long can a packet burst at maximum speed last? Explain your answer and derive any relation that you use. **(3 + 3) + (4 + 3) + (3 + 4)**

4. a) Describe briefly, the working of a WDMA network and explain in details how variable data rate connection oriented services are supported on it.

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




Network




Sink Tree for 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? **(4 + 4) + (6 + 2 + (2 + 2))**

5. a) Give the IEEE 802.16 frame format and explain in details.

b) Compare IEEE 802.11 with 802.16 and justify need for the later

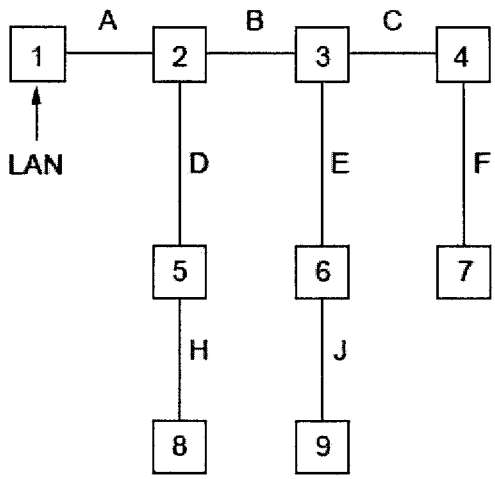
c) List the different classes of service supported in IEEE 802.16 and explain in details (with relevant diagrams) how these are implemented. **7+ (3 + 3) + 7**

6. a) Answer the following for IPv4:
   i) An IP packet has arrived with the first eight bits as (01000010 … ). The receiver discards the packet. Why?
   ii) In an IP packet, value of 'IHL' field is 1000 in binary. How many bytes of options are there in this packet?
   iii) An IP packet arrives with the first few hexadecimal digits as (45000028000100000102 … ). How many hops can this packet travel before being dropped?

b) What is subnet in the context of IPv4 and how is it specified in '/' notation? Explain clearly and illustrate with an example

c) An organization uses private IP addresses from the range 172.16.0.0-172.31.255.255/12 for its local computers. It also uses a NAT box for address translation to its Internet address: 198.60.42.12. Explain clearly how packets in a 'request – reply' session between a local computer client and a remote server on the Internet are handled.
**2×3 + (4 + 4) + 6**

7. a) Consider the spanning tree representation of LANs 1 through 9 connected by bridges A, B, C, D, E, F, H & J as shown below:




Hosts a, b, c and d are listed as
Host a & b on LAN1; Host c on LAN2; Host d on LAN8
Assuming hash tables of all bridges to be initially empty, show the change in table entries (stepwise) in individual bridges as the following events happen in sequence
   i) a sends to d
   ii) c sends to a
   iii) d sends to c
   iv) d relocated to LAN6
   v) d sends to a

b) A LAN uses the Mok and Ward's version of the Binary Countdown protocol. At a certain instant, the 10 stations in the LAN have virtual station numbers 8, 2, 4, 5, 1, 7, 3, 6, 9 and 10 in that order. The next three stations to transmit are 4, 3 and 9, in that order. What are the new virtual station numbers after all three have finished their transmission? Explain briefly.

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? **(8 + 6 + (2 × 3)**

8. Write short notes on any two:
   i) IEEE 802.3
   ii) Link State routing
   iii) Selective repeat sliding window protocol
   iv) IPv6 packet format
   **(2 × 10)**