EEL703/EEL473 Major

Semester II, 2007-08 – Apr-29-08
Electrical Engineering, IIT Delhi

Closed book, closed notes. One A4 size double-sided formula sheet allowed
Answer all questions. Write your answers to multiple choice questions on the answer book.
Be brief and to the point, and show all steps for full credit.
Return the question paper along with the answer script

Maximum time: 120 Minutes
Maximum points: 45

Name and Student ID:

1. Mark the wrong statement about the layered architecture [1]
   a. Has enabled availability of plug-and-play network components
   b. Helps efficient system design
   c. Can increase ruggedness in system functionality
   d. Helps market competition
   e. Decreases system design complexity

2. Mark the correct statement: Upper limit of frame size in CSMA/CD is dictated by [1]
   a. Network diameter
   b. Channel rate
   c. Simultaneous transmission and reception capability of network nodes
   d. Fairness to other users
   e. Processing speed at the receiver

3. Mark the wrong statement about DSSS system [1]
   a. The longer the code length the more amount of power required to transmit the signal
   b. The longer the code length the better the multi-user interference performance
   c. Helps mitigate the channel fading better
   d. Does not require frequency agile receiver filter

4. Mark the correct statement: Minimum weight spanning tree (MST), when compared with shortest paths (SP) from root to all nodes [1]
   a. Is identical in performance in terms of total weight of all paths
   b. Could have total weight smaller than that in SP
   c. Could have total weight higher than that in SP
   d. Should have total weight smaller than that in SP
   e. Should have total weight higher than that in SP

5. Which of the queuing types in an $n \times n$ nonblocking switches do(es) not suffer from head-of-line blocking? [1]
   a. Output queueing switch
   b. Input queueing switch
   c. Virtual output queuing switch
   d. All of the above
   e. (a) and (b)
   f. (b) and (c)
   g. (a) and (c)

6. Mark the correet answer: Birth-death processes are also [1]
   a. Sometimes independent processes
   b. Always Markov processes
   c. Sometimes semi-Markov processes
   d. Sometimes Poisson processes
   e. (a) and (b)
   f. (a) and (c)
   g. (b) and (c)
   h. (b) and (d)

7. Mark the corrcct statement: Imbedded Markov chain [1]
   a. Is a discrete-time version of continuous-time Markov chain
   b. Is a continuous-time version of diserete-time Markov ehain
   c. Is derived from the memoryless property of the service time distribution
   d. Has none of the above properties
   e. Has all of the above properties

8. Validity of Kleinrock independence assumption holds the following statement(s): [1]
   a. has nothing to do with the assumption of Poisson arrival process
   b. requires that the servicc times at various queues are indcpcndent
   c. is integrally related with the network conneetivity and volume of traffic
   d. all of the above
   e. (a) and (b)
   f. (a) and (c)
   g. (b) and (c)

9. Mark the wrong answer: In a diff-serv (prioritized) Internet service facility, [1]
   a. 911 emergency calls can be placed in non-preemptive priority traffic category
   b. Ordinary voice calls can be placed in preemptive priority traffic category
   c. Email messages can be placed in preemptive priority traffic category
   d. telnet sessions can be placed in non-preemptivc priority traffic category

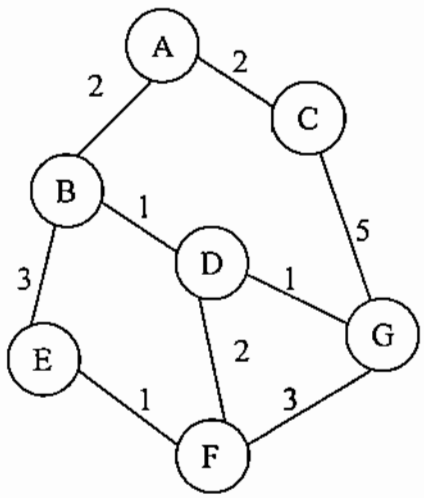
10. Mark the correct statement: In a link layer two-way data transfer with cxponentially distributed frame size in both directions and using GBN-ARQ, putting ACK in the trailer (just before CRC) [1]
    a. Is technically impossible at the first place
    b. Does not make any difference with respect to the case where ACK were placed in the header
    c. Docs makc some difference with respeet to increased frame success probability
    d. Improves the averagc delay performance per successful framc
    e. Has a different effect unlike in delayed ACK in TCP window protocol

11. Whieh of the following generator polynomial $g(x)$ values guarantees that a single-bit error is dctected? For each case, what is the single-bit error that cannot be caught? [6]
    a. $x+1$
    b. x^3
    c. 1

12. Consider a single server queueing system having infinite buffer and with discouraged arrival process, i.e., the customer arrival rate at state k is $\lambda_k = \alpha/(k+1)$, $k = 0, 1, 2, \cdots$, α is an appropriate constant, and the service rate $\mu_k = \mu$, $k = 0, 1, 2, \cdots$. Obtain the probability of finding n customers in the system. Also obtain the average arrival rate in the system. Show all steps elearly for full credit. **[7]**

13. Consider an *M/M/m/m* cireuit switched system, $m = 5$ eireuits, serving two classes of serviee, with one class having service priority over the other. The first type of eustomers are always guaranteed 2 circuits. Assume that the first type of customers' arrival rate is 1 *call per min.* and average service time is 2 *min.*, while for the second type of eustomers thesc figures are 2 *calls per min.* and 3 *min.*, respeetively.
    a. Draw the Markov chain to represent the state transition rclationships among different states of the system. Clearly show the transition rates. **[3]**
    b. Probability of finding the system having n_1 *type*-1 customers and n_2 *type*-2} customers is denoted by $P(n_1, n_2)$. Write down the ranges of n_1 and n_2 within which *type*-1 customers can be blockcd. Also, write down the ranges of n_1 and n_2 within which *type*-2 customers can be blocked. **[3]**

14. Consider a CSMA/CD system with maximum propagation and detcction delay β. What is the maximum time interval between the start of a collision event at one end and its end at the other end? What is the maximum time interval over which a transmitting node ean hear a collision? Justify your answer with proper reasoning. **[2]**
15. $\mathcal{G} = (\mathcal{N}, \mathcal{A})$ is a connected graph, with N nodes and A links.
    a. $\mathcal{G}' = (\mathcal{N}, \mathcal{A}')$ is a subgraph of $\mathcal{G}$ with N′ nodes and A′ links. $\mathcal{G}'$ to be a spanning tree, what is the minimum value of A′? What is the maximum value of A′? **[2]**
    b. A graph $\mathcal{G}$ with bidirectional links is shown in figure below. Construet a minimum-weight spanning tree (MST) with the root at A. Use any known MST algorithm (indicate it). Show all iteration steps clearly. **[4]**



    c. Construct shortest path to all nodcs from the node A. Usc any known shortest path algorithm (indicate it). Show all iteration steps elearly. **[4]**
    d. What is the distanee between A and E in part (b)? What is the distance between A and E in part (c)? What are the total weights of the MST and thc shortest path that you constructed. Comment on your results. **[4]**