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## CS-703

**B. E. (Seventh Semester) EXAMINATION, June, 2010**

**(Computer Science & Engg. Branch)**

**SIMULATION AND MODELING**

**(CS-703)**

*Time : Three Hours*

*Maximum Marks : 100*

*Minimum Pass Marks : 35*

**Note :** Attempt any *five* questions. All questions carry equal marks.

1. (a) Identify at least *one* problem where you think analog, continuous-time simulation might not be appropriate and describe why this might be so.  
(b) The time intervals between dial-up connections to an internet service provider are exponentially distributed with a mean of 15 seconds. Find the probability that the third dial-up connection occurs after 30 seconds have elapsed.
2. (a) Differentiate between the following :  
Discrete and Continuous-probability function.  
(b) A tool crib has exponential interarrival and service times, and it serves a very large group of mechanics. The mean time between arrivals is 4 minutes. It takes 3 minutes on the average for a tool-crib attendant to

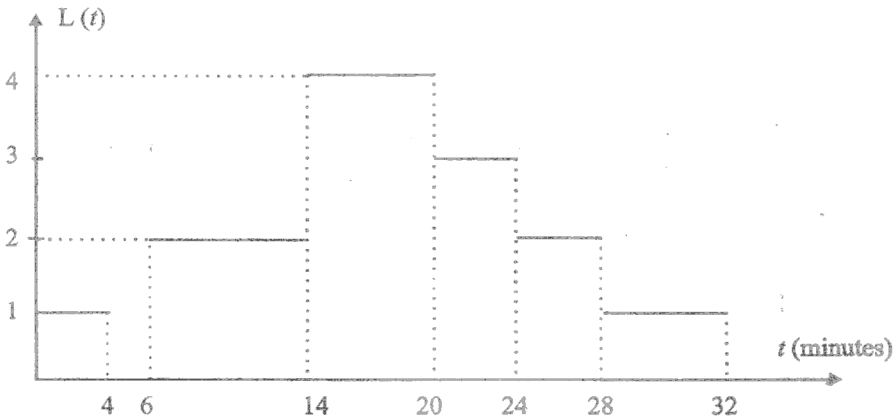
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service a mechanic. The attendant is paid \$ 10 per hour and the mechanic is paid \$ 15 per hour. Would it be advisable to have a second tool-crib attendant ?

3. (a) Differentiate between random numbers and pseudo-random numbers. How could random numbers that are uniform on the interval  $[0, 1]$  be transformed into random numbers that are uniform on the interval  $[-11, 17]$  ?
- (b) Consider a single-server queue, with a Poisson arrival rate  $\lambda$ . The service times are independent identically distributed.
- (i) Assume that the service times of the customers follow the exponential distribution with mean  $1/\mu$ . Show that the average number of arrivals during a service time is  $N = \lambda/\mu$ .
- (ii) For the M/M/1 queue of part 1, find the probability distribution of the number of arrivals during a service time
- (iii) Assume that the service times follow a general distribution with mean  $1/\mu$ . Show that the average number of arrivals during a service time is, again,  $N = \lambda/\mu$ .
4. (a) Explain with the help of an example, the principles used in modeling.
- (b) Derive Little's equation/conservation equation. Given that in a queuing system there is one arrival every 4 minutes on the average and each arrival spends 4.6 time units in the system, determine the average number of customers in the system.

5. (a) What is System Dynamics modeling ? Explain causal loop diagrams and flow diagrams with example.
- (b) A topic frequently in the news is the health (or lack thereof) of the US Social Security System. As in many nations, the US Social Security System is 'pay as you go': revenue received today from taxes paid by workers and their employers is used to pay benefits to those over the age of sixty-five. For the purpose of this question, assume that people start working at age twenty and begin receiving social security benefits at age sixty-five. Map the stock and flow structure of the US population as it relates to the social security system. Also map the stock and flow structure of money as it goes through the system. You should have two separate stock flow chains in this answer, one for people, one for money. Make sure they are appropriately linked with information arrows.
6. A communication line capable of transmitting at a rate of 50 kbps will be used to accommodate 10 sessions each generating Poisson traffic at a rate 150 pkts/min. Packet lengths are exponentially distributed with mean 1000 bits :
- (a) For each session, find the average number of packets in queue, the average number in the system, and the average delay per packet when the line is allocated to the sessions by using :
- (i) 10 equal-capacity time-division multiplexed channels.
  - (ii) Statistical multiplexing.
- (b) Repeat part (a) for the case where five of the sessions transmit at a rate of 250 packets/min. while the other five transmit at a rate of 50 packets/min.

7. (a) Prove that exponential distribution is memoryless.
- (b) Suppose that the following figure represents the number of customers in system for a last-in, first-out (LIFO) single-server queuing system. If two customers arrive at the same time, either one is served first
- Estimate  $L$
  - Estimate  $W$



8. Write short notes on any *two* of the following :
- Classification of simulation language
  - Probability concepts in simulation process
  - Simulation programming techniques