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**M .TECH**
EIPC 202

# Second Semester Examination – 2013
## MODELING AND SIMULATION

**Time: 3 Hours**

**Max marks: 70**

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) What is a 'Stochastic Process'? Give an example of a 'Stochastic Process'.

b) Explain Rejection method for generating continuous random variables.

c) If $x_0 = 2$ and $x_n \equiv x_{n-1} \ (mod\ 11)$, find $x_1, x_2, x_3, x_4, x_5$

d) Write a subroutine to generate Poisson random variable

e) Explain the concept of inverse transform method of generating a random variable.

f) What are antithetic variables? What is the use of these variables in simulation?

g) What is 'simlib'? Write the name of variables and arrays are used or set by the user during the simulation by 'simlib'.

h) Why validation of simulation model is required? State two statistical validation techniques

i) How do you differentiate between attribute and activity of system? Give an example of one attribute and one activity of a traffic system.

j) Write the description of a metal-parts manufacturing system.

Q2 a) Describe the method of simulation of an Inventory System. (5)

b) Explain the simulation technique to evaluate the following integral using Monte Carlo Simulation Technique (5)

$$I = \int_a^b f(x)dx$$

where f(x) is a real-valued function that is not analytically integrable.

Q3 a) Explain simulation technique to simulate a model of time-shared computer facilities. (5)

b) Write the Flowchart for the simulation output of the this time-shared computer model. (5)

Q4 a) We wish to generate a random variable X taking values in [0, 1], having probability density function (5)

$$f(x) = e^x / (e-1)$$

Write a program based on the inverse transform method to generate X.

b) Buses arrive at a sporting event according to a Poisson process with a rate 5 per hour. Each bus is equally likely to contain either 20, 21, . . . , 40 fans, with the numbers in the different buses being independent. Write an algorithm to simulate the arrival of fans to the event by time t=1. (5)

Q5 Suppose that jobs arrive at a single server queueing system according to a nonhomogeneous Poisson process, whose rate is initially 4 per hour, increases steadily until it hits 19 per hour after 5 hours, and then decreases steadily until it hits 4 per hour after an additional 5 hours. The rate then repeats indefinitely in this fashion—that is, $\lambda(t + 10) = \lambda(t)$. Suppose that the service distribution is exponential with rate 25 per hour. Suppose also that whenever the server completes a service and finds no jobs waiting he goes on break for a time that is uniformly distributed on (0, 0.3). If upon returning from his break there are no jobs waiting, then he goes on another break.

a) Write function $\lambda(t)$ and subroutine to compute the time of first arrival after time t in the queueing system. (5)

b) Write an algorithm for simulation to estimate the expected amount of time that the server is on break in the first 100 hours of operation. (5)

Q6 a) Explain how antithetic variables can be used in obtaining a simulation estimate of the quantity (5)

$$\theta = \int_0^1 \int_0^1 e^{(x+y)^2}\,dx\,dy$$

Is it clear in this case that using antithetic variables is more efficient than generating a new pair of random variables?

b) Suppose that X is an exponential random variable with mean 1. Give another random variable that is negatively correlated with X and that is also exponential with mean 1. (5)

Q7 a) Explain a method for generating random variable of a standard normal distribution (that is, with mean 0 and variance 1) (5)

b) Explain how control variables may be used to estimate $\theta$, where (5)

$$\theta = \int_0^1 e^{x^2}\,dx$$

Q8 Describe any <u>TWO</u> from the following (5+5=10)

a) Write the steps in simulation study
b) Testing of random Number Generators
c) Objectives of Simulation in Manufacturing
d) Stratified sampling in variance reduction