

Time – 3.00 Hours
Full Marks: 70

(Answer any SIX questions including Question No. 1 which is compulsory)
The figures in the right-hand margin indicate marks

- 1 Answer the following questions: [2X10]
- (a) How can you ascertain that a set of data points are exponentially distributed?
- (b) Distinguish between physical model and mathematical model.
- (c) What is the relationship between the three central tendency parameters?
- (d) Explain Monte Carlo Method.
- (e) Differentiate between fixed time – step and event-to-event model.
- (f) What is a distributed Lag model?
- (g) How is the service time modeled?
- (h) What is the role of length of simulation runs on simulation of a system?
- (i) Name two simulation languages that are commonly used for combined system.
- (j) What is Chi-square test? Why it is used?

- 2 (a) Determine the value of π by employing Monte Carlo method. Use 10 pairs of random numbers. How do you increase its accuracy? [5+5]
- (b) Draw the analog computer model described by the equations.

$$\begin{aligned} \dot{x}_1 &= -k_{12}x_1 + k_{21}x_2 \\ \dot{x}_2 &= k_{12}x_1 - (k_{21} + k_{23})x_2 \\ \text{and } \dot{x}_3 &= k_{23}x_2 \end{aligned}$$

- 3.(a) Differentiate between static and dynamic mathematical models with examples. Derive the condition for the motion to occur without oscillation for a system representing the suspension of an automobile wheel when the body is assumed to be immobile in a vertical direction. [6+4]
- (b) Draw a Cobweb model for the following market:
 $D = 12.4 - 1.2 P$
 $S = 8.0 - 0.6 P_{-1}$
 $P_0 = 1.0$
 and find out whether the market is stable or not?

- 4.(a) What are the qualities of an efficient random number generator? Describe a procedure to generate random numbers in the interval [0,1] with two-digit accuracy. [5+5]
- (b) A sequence of 10 random numbers between 0 and 40 is to be generated such that

$$r_{n+1} = (9r_n + 15) \text{ modulo } m.$$

Take the seed as 12 and use the mixed congruential method to generate the same.

- 5.(a) Taking document processing as an example, explain numerical computational technique for the simulation of the discrete system.
- (b) Name the methods of generation of non-uniformly distributed random numbers. Write the rejection procedure to generate a required number of samples and show it graphically also. [5+5]
- 6.(a) List various methods for generation of random observations from discrete distributions. What is Erlang distribution? Explain the role of Erlang shape factor on the distribution and show them graphically.
- (b) (i) Generate three random varieties from an Erlang distribution having mean and shape factor 4.
(ii) Generate five random varieties from the following distribution:
- $$f(x) = \begin{cases} (1/50)^{(x-5)}, & \text{if } 10 \leq x \leq 20 \\ 0 & \text{otherwise} \end{cases} \quad [4+6]$$
- 7.(a) Explain the role and significance of VRT. Given the exponential distribution with parameter having value 5, generate 10 random observations and calculate the resulting estimate of mean by stratified sampling method. [6+4]
- (b) What are the factors to be considered in selection of a discrete system simulation language? Explain them.