[This question paper contains 3 printed pages.]

8039 *Your Roll No.* .....

B.Sc./III **JS**

MATHEMATICAL SCIENCES

(OPERATIONAL RESEARCH)

Paper V – Queueing Theory and Reliability

Time : 3 hours *Maximum Marks : 55*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer **five** *questions in all, selecting at least* **two** *questions from each Section.*

SECTION A
(Queueing Theory)

1. (a) Discuss the various characteristics of a Queueing system. (4)

   (b) For the queueing model D/D/1/K-1, obtain n(t), the number of units in the system at time t, and W_q, the waiting time of the n^{th} arrival before his service starts. Assume that initially the system is empty and the service duration is a multiple of the inter-arrival time. (7)

P.T.O.

2. Derive the steady state distribution of the number of units in the system $M|M|C:\infty/FIFO$. (11)

3. (a) Show that the sum of k independent and identically distributed exponential random variables with mean $(1/k_\mu)$ follows Erlang type k distribution with parameter μ. (4)

(b) Obtain the probability generating function for the number of stages in the queueing system $M|E_K|1$. (7)

4. Write notes on the following :

(i) Bulk queueing systems

(ii) Simulation in queueing systems (11)

SECTION B
(Reliability)

5. (a) Define the following terms :

(i) Reliability function

(ii) Hazard rate function

(iii) MTSF (3)

(b) Consider a system with constant failure rate λ. Find the probability that –

(i) System fails in first 20 hrs.

(ii) System fails in next 15 hrs given that it has not failed in first 50 hrs. (5)

(c) Prove that failure rate of a series system is the sum of the failure rates of its components. (3)

6. (a) Explain briefly series, parallel and stand-by systems. (5)

(b) Find the availability of a one unit system with constant failure and repair rates, respectively. (6)

7. What is Up-Time Ratio (UTR)? Derive UTR for a circuit series system with constant failure and repair rates with one repair facility. (11)

8. (a) Explain the following :–

(i) Age replacement

(ii) Corrective maintenance and

(iii) Preventive maintenance (6)

(b) Discuss the replacement policy of items that deteriorate gradually under the case when the value of money does not change with time. (5)