

[This question paper contains 3 printed pages.]

4689

Your Roll No.

B.Sc./III/NS

AS

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 various characteristics of a queueing system. (4)
- (b) For a deterministic queueing model $D/D/1 : K-1$, obtain $n(t)$, the number of units in the system at time t , and $w_q^{(n)}$, waiting time of the n th arrival before his service starts. Assume that, initially the system is empty. (7)
2. (a) A departmental store has a single cashier. During the rush hours, customers arrive at the rate 20 customers/hr. The average number of customers

P.T.O.

that can be processed by the cashier is 24 per hour. Assume that the arrivals and processing are Poisson.

Find the

- (i) Probability that the cashier is idle.
 - (ii) Average number of customers in the system.
 - (iii) Average time a customer spends in the system. (5)
- (b) Derive the steady state probability distribution of the number of units in the M/M/2 queueing system. (6)
3. What is a bulk queueing system? Obtain generating function of the steady state probability distribution of the number of customers in the system $M^{(X)}/M/1$. (11)
4. Write notes on the following :
- (i) Method of stages
 - (ii) Simulation in queueing theory (11)

SECTION B

(Reliability)

5. (a) Differentiate between reliability and availability of a system. (3)

- (b) For large MTBF, which arrangement of n components is preferable: standby or parallel system. Explain. (4)
- (c) Suppose that failure time distribution of a system is exponential with parameter λ . Find
- (i) $P(\text{system fails in first 10 hrs})$ &
 - (ii) $P(\text{system fails in next 10 hrs/ it has not failed in 100 hrs})$. (4)
6. Derive MTSF of a 2-unit standby system with constant failure and repair rates. Assume that units are identical. (11)
7. What is Up Time Ratio (UTR)? Derive UTR for a series system with constant failure and repair rates. (11)
8. (a) Explain the difference among:
- (i) Age replacement
 - (ii) Corrective maintenance and
 - (iii) Preventive maintenance (6)
- (b) Discuss the replacement policy for items that deteriorate gradually under the case when value of money changes with time. (5)