

[This question paper contains 3 printed pages]

*Your Roll No*

7234

J

M.Sc./I

OPERATIONAL RESEARCH

Course VI—Queuing Theory

(Admissions of 2001 and onwards)

*Time 3 Hours*

*Maximum Marks 75*

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

*Attempt any five questions*

- 1 What is a multi-channel queuing system ? Derive the steady-state difference equations for a  $M/M/C (\infty | F_c F_s)$  system

Also obtain

- (i) Steady-state probability distribution for the number of units in the system
  - (ii) Expected number of busy servers
  - (iii) Expected waiting time in the queue 15
- 2 (a) Perform a comparative analysis of  $M/M/1$  and  $M/M/2$  queuing systems with same traffic intensity Which one is better out of two and why ? Justify your answer 7

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- (b) Obtain steady-state system size distribution for  
M/M/1 model under (0, R) policy 8
- 3 What are the bulk queuing systems ? Derive steady-state difference equations for the number of units in the system  $M^{(X)}/M/1$  and hence obtain the probability generating function for the steady-state distribution  
Also discuss the particular case when batch size has a Geometric distribution. 15
- 4 Explain the concept of Imbedded Markov chains for analysing non-Markovian queuing systems Obtain steady-state distribution for number of units in the system  $G1/M/1$   
Also prove that distribution for non-zero waiting time in queue is exponential. 15
- 5 (a) Distinguish between transient and steady-state solutions ? Point out importance of transient solutions in queuing theory 6  
(b) Obtain  $\bar{P}(z, s)$ , Laplace transform of the probability generating function of the transient system size distribution for  $M/M/1$  system. State, in brief, the steps to be used for determining the transient system size distribution 9
- 6 Obtain the probability generating function for the number of units in the system under steady-state for the queuing system  $M/D/C$  15

- 7 (a) Define a Markov chain. Discuss the following concepts 8
- (i) Irreducible Markov chain,
  - (ii) Transient and recurrent states,
  - (iii) Limiting distribution and stationary distribution for a Markov chain
- (b) What is simulation? What are the advantages and disadvantages of analysing a queuing system through simulation? 7