

QP CODE: 26019095



Reg No :

Name :

M.Sc DEGREE (CSS) EXAMINATION, MARCH 2026

Fourth Semester

M Sc MATHEMATICS

ELECTIVE - ME810402 - OPERATIONS RESEARCH

2019 Admission Onwards

B2F31968

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. What are the characteristics of dynamic programming?
2. Define monotonic non-decreasing and monotonic non-increasing function.
3. State the continuous analogue of forward recursion formula of dynamic programming.
4. When do you say that a random process is stationary? Give an example.
5. Determine the values of missing entries in the instantaneous transition rate matrix of a Markov process,

$$\begin{bmatrix} - & 1 & 0 & 0 \\ 0.8 & - & 2.6 & 0.1 \\ 1.5 & 2 & - & 2 \\ 1 & 0 & - & -4 \end{bmatrix}. \text{ Justify your answer.}$$

6. Define a renewal process. Give an example of a renewal process.
7. What is Little's Formula? Write the Little's formula for
(a) an infinite capacity system (b) the queue portion of a queueing system.
8. Briefly explain the term traffic intensity.
9. Give the formulas for optimum order quantity Q and minimum cost per unit time C of the EOQ model with shortages allowed.





10. In the newsboy problem, assume that the demand is uniformly distributed over the range $[a, b]$. Then obtain an explicit, closed-form expression for Q .

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. How to solve single additive constraint, additively separable return type optimization problem using D.P.P.
12. Determine $\max z = u_1 u_2 u_3$ subject to $u_1 + u_2 + u_3 = 10, u_1, u_2, u_3 \geq 0$.
13. Find the limiting distribution of a Markov process with instantaneous transition rate matrix

$$\begin{bmatrix} -2.5 & 1 & 1.5 \\ 4 & -4 & 0 \\ 0 & 2 & -2 \end{bmatrix}.$$

14. A birth and death process has parameters $\lambda_k = \alpha \cdot (k + 1)$ and $\mu_k = \beta \cdot (k + 1)$; $k = 0, 1, 2, \dots$. Assuming $\alpha < \beta$, determine the limiting distribution of the process.
15. Write and solve the steady state equations for the limited queue capacity model M/M/1/4.
16. Derive the steady state probability of an M/M/c/c queue.
17. What are the economic parameters associated with an inventory problem.
18. A contractor has to supply an item 20,000 units per day. He can produce it 30,000 units per day. The cost of holding an item in store is Rs. 3 per year and setup cost per run is Rs. 50. How frequently and of what size the production run be made.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. Use D.P.P. to find maximum value of $u_1^2 + u_2^2 + u_3^2$ subject to $u_1 u_2 u_3 \leq 6$, where u_1, u_2, u_3 are positive integers.
20. Define continuous time Markov process. Derive steady state probabilities for a continuous time Markov chain using Chapman-Kolmogorov equations.
21. (a) What is meant by a finite source queueing model?
(b) Derive the steady – state probability distribution of the M/M/1/N/N queueing model.





22.

(a) A Cafeteria uses up paper napkins at the rate of 12 boxes per week. They are so bulky that it is a nuisance to store many boxes. For accounting purposes, the company figures that the space costs 20 cents per box per week. The cost of placing an order and the handling that is involved when it arrives, regardless of the size of the order, is \$10.00. How frequently should the orders be placed, and for how many boxes?

(b) A Company that has a definite plan for expansion will need to hire and train 60 new engineers per year. The cost of running a training program is \$20,000, independent of the number of trainees. These engineers earn annual salaries of \$30,000, so the company prefers not to hire and train them before they are needed. On the other hand, they must be available when they are needed; and since it costs so much to train them, they will be trained in advance of the time they are needed and in groups. They receive full salary while in the pool of trained, but not yet needed, engineers. What should the training-group size be, how often will the six-week training session be held, and how much will these program host the company.

(2×5=10 weightage)

