**Roll No.** _______ **Code No. Q-4397**

# FOURTH SEMESTER EXAMINATION 2021-22

## M.Sc. Mathematics

## Paper - V

## Operation Research - II

**Time : 3.00 Hrs.** **Max. Marks : 80**

**Total No. of Printed Page : 04** **Mini. Marks : 29**

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**Note:- Question paper is divided into three sections. Attempt question of all three section as per direction Distribution of marks is given in each section.**

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### Section 'A'

**Very short answer question (in few words)**

Q.1 Attempt any six questions from the following : 6x2=12

(i) State Bellman's principle of optimality in dynamic programming.

(ii) Who was developed first a symmetric procedure for solving an all integer programming problem.

(iii) Explain strategy and value of the game.

(iv) Define general non-linear programming problem with suitable examples.

(v) Explain quadratic programming.

(vi) Explain Separable programming.

(vii) Write characteristic of queuing system.

(viii) Write steady state equations of the system model-I.

$(M/M/1):(\infty/FCFS)$.

(ix) What are the applications of dynamic programming.

(x) Define inventory with suitable examples.

## Section 'B'

**Short answer type question (in 200 words)**

Q.1 Attempt any four questions from the following : 4x5=20

(i) Write characteristic of dynamic programming problem.

(ii) Explain the theory of dominance rule in the solution of rectangular games with suitable examples.

(iii) Customers arrive at a sales counter manned by a single person according to a poisson process with a mean rate of 20 per hour. The time required to serve a customer has an exponential distribution with a mean of 100 seconds. Find the average waiting time of a customer and queue length.

(iv) Reduce the following games to $(2 \times 2)$ by graphical method & hence solve the games :

$$\begin{array}{cc} & B \\ & \begin{array}{ccc} I & II & III \end{array} \\ A & \begin{array}{c} I \\ II \end{array} \begin{bmatrix} 1 & 3 & 11 \\ 8 & 5 & 2 \end{bmatrix} \end{array}$$

(v) Describe Branch and Bound technique to solve an integer programming problem.

(vi) Find the maximum value of $z = x_1^2 + 2x_2^2 + 4x_3$

subject to the constraints $x_1 + 2x_2 + x_3 \leq 8$

where $x_1, x_2, x_3 \geq 0$

(vii) Find the system of steady state equation of the model - III.

$(M / M / 1):(N / FCFS)$.

## Section 'C'

**Long answer/Essay type question.**

Q.3 Attempt any four questions from the following questions : 4x12=48

(i) Use dynamic programming to solve the following linear programming problem :

Max. $z = 3x_1 + 5x_2$

Subject to constraints $x_1 \le 4$

$x_2 \le 6$

$3x_1 + 2x_2 \le 18$ where $x_1, x_2 \ge 0$

(ii) Solve the following L.P.P. by Gomory technique :

Max $z = 3x_2$

Subject to the constraints $3x_1 + 2x_2 \le 7$

$x_1 - x_2 \ge -2$ Where $x_1, x_2 \ge 0$ and are integers.

(iii) For any (2x2) two person zero sum game without any saddle point and having pay-oof matrix for player A as

$$\begin{array}{cc} & \textit{Player B} \\ & \begin{array}{cc} I & II \end{array} \\ \textit{Player A} & \begin{array}{c} I \\ II \end{array} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \end{array}$$

Find the optimum mixed strategies.

(iv) Find the system of steady state equation and solution of the model-I. $(M/M/1):(\infty/FCFS)$.

(v) Apply Wolfe's Method to solve the quadratic programming problem :

Max. $z = 2x_1 + 3x_2 - 2x_1^2$

Subject to the constraints $x_1 + 4x_2 \le 4$

$x_1 + 2x_2 \le 2$ Where $x_1, x_2 \ge 0$

(vi) Solve the following quadratic programming problem by using Beale's method :

Max. $z = 2x_1 + 3x_2 - x_1^2$

Subject to the constraints $x_1 + 2x_2 \le 4$ Where $x_1, x_2 \ge 0$

(vii) With the help of Kuhn-Tucker conditions solve the following non-linear programming problem :

Max. $z = 2x_1 - x_1^2 + x_2$

Subject to the constraints $2x_1 + 3x_2 \le 6$

$2x_1 + x_2 \le 4$ Where $x_1, x_2 \ge 0$

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