LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **STATISTICS**

SIXTH SEMESTER – **APRIL 2024**

UST 6502 – OPERATIONS RESEARCH

Date: 08-04-2024 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

	SECTION A – K1 (CO1)
	Answer ALL the questions **(10 x 1 = 10)**
1	**Define the following**
a)	Feasible solution
b)	Duality
c)	Unbalanced Transportation problem
d)	Critical Path
e)	Saddle Point
2	**Fill in the blanks**
a)	Operations research is the application of _____methods to arrive at the optimal Solutions to the problems.
b)	The linear function of the variables which is to be maximized or minimized is called _____
c)	The penalty in VAM represents difference between _____ cost of respective row /column.
d)	_____ method is used when three time estimates are given in a network diagram**.**
e)	In game theory, a situation in which one firm can gain only what another firm loses is called a _____
	SECTION A – K2 (CO1)
	Answer ALL the questions **(10 x 1 = 10)**
3	**True or False**
a)	Operations research is a very powerful tool for decision making.
b)	Feasible solution satisfies only constraints.
c)	Hungarian method is used to solve assignment problem.
d)	An activity is critical if its free float is zero
e)	A negative payoff indicates a loss to the row player.
4	**Match the following**
a)	Operations Research - Total float
b)	LPP involving only 2 variables – Saddle Point
c)	Transportation Problem – Multi Disciplinary
d)	Critical path Method – Graphical solution
e)	Game Theory – North west corner rule
	SECTION B – K3 (CO2)
	Answer any TWO of the following **(2 x 10 = 20)**
5	Explain the advantages and limitations of operations research.
6	A manufacturer produces two different models X and Y of the same product. The raw materials r_1 and r_2 are required for production. At least 18 kg of r_1 and 12 kg of r_2 must be used daily. Also at most 34 hours of labour are to be utilized. 2 kg of r_1 are needed for each model X and 1 kg of r_1 for each model of Y. for each model of X and Y 1 kg of r_2 is required. It takes 3 hours to manufacture a model X and 2 hours to manufacture a model Y. The profit is Rs. 50 for each model X and Rs. 30 for each model Y. Formulate the problem as an LPP and find the optimum solution of each model should be produced to maximize the profit? Use graphical method

7	Explain how you will solve assignment problem using Hungarian Method.
8	A small project consists of seven activities for which the relevant data are given below: <table><tr><td>Activity</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td></tr><tr><td>Preceding Activities</td><td>-</td><td>-</td><td>-</td><td>A,B</td><td>A, B</td><td>C, D, E</td><td>F</td></tr><tr><td>Activity duration (Days)</td><td>4</td><td>7</td><td>6</td><td>5</td><td>7</td><td>6</td><td>5</td></tr></table>Draw the network (arrow) diagram and find the critical path. Also find the expected time of the project.
SECTION C – K4 (CO3)	
	Answer any TWO of the following (2 x 10 = 20)
9	**Discover the steps involved in the Simplex algorithm**
10	**Use duality to solve the following linear programming problem:** $Max\ z = 5x_1 + 3x_2$ **Subject to** $4x_1 + 2x_2 \le 10;\ \ 2x_1 + 2x_2 \le 8;\ \ x_1, x_2 \ge 0$
11	Certain equipment needs five repair jobs which have to be assigned to five machines. The estimated time (in hours) that each machine requires to complete the repair job is given in the following table: <table><tr><td>Machine</td><td colspan="5">Job</td></tr><tr><td></td><td>J_1</td><td>J_2</td><td>J_3</td><td>J_4</td><td>J_5</td></tr><tr><td>M_1</td><td>7</td><td>5</td><td>9</td><td>8</td><td>11</td></tr><tr><td>M_2</td><td>9</td><td>12</td><td>7</td><td>11</td><td>10</td></tr><tr><td>M_3</td><td>8</td><td>5</td><td>4</td><td>6</td><td>9</td></tr><tr><td>M_4</td><td>7</td><td>3</td><td>6</td><td>9</td><td>5</td></tr><tr><td>M_5</td><td>4</td><td>6</td><td>7</td><td>5</td><td>11</td></tr></table>Assuming that each machine can be assigned to only one job, determine the minimum time assignment.
12	Explain the procedure for solving (2 x n) and (m x 2) games graphically.
SECTION D – K5 (CO4)	
	Answer any ONE of the following (1 x 20 = 20)
13	Use dual simplex method to the following linear programming problem: $Min\ z = 10x_1 + 6x_2 + 2x_3$ Subject to $-x_1 + x_2 + x_3 \ge 1;\ 3x_1 + x_2 - x_3 \ge 2;\ x_1, x_2, x_3 \ge 0$
14	ABC limited has three production shops supplying a product to five warehouses. The cost of production varies from shop to shop and cost of transportation from one shop to a warehouse also varies. Each shop has a specific production capacity and each warehouse has certain amount of requirement. The cost of transportation are as given below: <table><tr><td>Shop</td><td colspan="5">Warehouse</td><td>Capacity</td></tr><tr><td></td><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td><td></td></tr><tr><td>A</td><td>20</td><td>18</td><td>18</td><td>21</td><td>19</td><td>100</td></tr><tr><td>B</td><td>21</td><td>22</td><td>23</td><td>20</td><td>24</td><td>125</td></tr><tr><td>C</td><td>18</td><td>19</td><td>21</td><td>18</td><td>19</td><td>175</td></tr><tr><td>Requirement</td><td>60</td><td>80</td><td>85</td><td>105</td><td>70</td><td>400</td></tr></table>Find the optimum quantity to be supplied from each shop to different warehouses at minimum total cost.
SECTION E– K6 (CO5)	

	Answer any ONE of the following **(1 x 20 = 20)**
15	The following optimistic (O) , pessimistic (P) and most likely (M) time estimates(days) for each task have been given for a project:

Task	Predecessors	O	M	P
A	-	5	8	10
B	-	18	20	22
C	-	26	33	40
D	A	16	18	20
E	A	15	20	25
F	B	6	9	12
G	C	7	10	12
H	D	7	8	9
I	E, F	3	4	5

(i) Construct the network diagram for this project.
(ii) Determine Expected task time and their variance.
(iii) Determine the earliest and latest expected times to reach each project.
(iv) Find the critical path and the expected duration of the project.
(v) What is the probability that the project will have 95% chance of being completed?

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a. Solve the following game using graphical method

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{cc} B_1 & B_2 \end{array} \\ \begin{pmatrix} 3 & -4 \\ 2 & 5 \\ -2 & 8 \end{pmatrix} \end{array}$$

b. Using dominance method solve the game with the following payoff matrix:

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{cccc} B_1 & B_2 & B_3 & B_4 \end{array} \\ \begin{pmatrix} 8 & 10 & 9 & 14 \\ 10 & 11 & 8 & 12 \\ 13 & 12 & 4 & 13 \end{pmatrix} \end{array}$$

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