A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code:R4D06

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

R21UCB406- INTRODUCTION TO OPERATIONS RESEARCH

(Computer Science and Business Systems)

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The maximization problem in the primal becomes the _____problem in the dual CO6- U

   (a) Primal (b) Minimization (c) Normal (d) Exponential

2. The entering variable is the non-basic variable corresponding to the__ CO6- U

   (a) $Z_j - C_j$ (b) $Z_j + C_j$ (c) $Z_j = C_j$ (d) $Z_j \geq C_j$

3. Degeneracy in $m \times n$ transportation problem occurs when the number of occupied cells is _____ then _____ CO6- U

   a) equal,m+n-1 b) Less,m+n-1 c) Less,m+n+1 d) more,m+n-1

4. For solving an assignment problem which method is used CO6- U

   (a) Hungarian (b) German (c) American (d) None of these

5. Minimum inventory equals CO6- U

   (a) EOQ (b) Reorder level (c) Safety stock (d) reduce stock

6. The formula for EOQ under deterministic demand and with shortage where lead time is zero is _____ CO6- U

   (a) $\sqrt{\frac{c_1 + c_2}{c_2}}\sqrt{\frac{2c_3R}{c_2}} = Q_0$ (b) $\sqrt{\frac{c_1 + c_2}{c_2}}\sqrt{\frac{2c_3R}{c_1}} = Q_0$ (c) $\sqrt{\frac{c_1 + c_2}{c_2}}$ (d) $\sqrt{\frac{2c_3R}{c_1}} = Q_0$

7. In M/M/C, The effective arrival rate is ___ CO6 - U

(a) λ (b) λ' (c) μ' (d) $\lambda\mu'$

8. In queue description (M/M/1) : (10 /FIFO) the number of server is CO6- U

(a) 1 (b) 2 (c) 10 (d) ∞

9. The size of payoff matrix of game can be reduced by using the principle of CO6 - U

(a) Dominance (b) Rotation reduction (c) Game inversion (d) Game Transpose

10. The saddle point of $\begin{pmatrix} -4 & 3 \\ -3 & 7 \end{pmatrix}$ _____ CO6- U

(a) 1 (b) 2 (c) 3 (d) does not exist

PART – B (5 x 2= 10 Marks)

11. Define the terms CO6- U

(i) Non-degenerate basic solution

(ii) Degenerate basic solution.

12. Distinguish between a transportation problem and an assignment problem CO6- U

13. Define lead time, Reorder level. CO6 -U

14. Explain Kendall's Notation (a/b/c): (d/e) of a queueing model CO6 -U

15. Solve using dominance CO5 -App

$$A \begin{matrix} \\ \\ \\ \end{matrix} \begin{matrix} B \\ \begin{matrix} \text{I} & \text{II} & \text{III} \end{matrix} \end{matrix} \begin{bmatrix} 6 & 8 & 6 \\ 4 & 12 & 2 \end{bmatrix}$$

PART – C (5 x 16= 80 Marks)

16. (a) Solve the following L.P .P graphically CO1- App (16)

Maximize $Z = 6000X_1 + 4000X_2$

subject to the constraints

$3X_1 + X_2 \geq 40$

$X_1 + 2.5X_2 \geq 22$

$3X_1 + 3X_2 \geq 40$

and $X_1, X_2 \geq 0$

Or

(b) Solve by simplex method. CO1- App (16)

Minimize $Z = 5x_1 - 6x_2 - 7x_3$

Subject to the constra int

$x_1 + 5x_2 - 3x_3 \geq 15$, $5x_1 - 6x_2 + 10x_3 \leq 20$, $x_1 + x_2 + x_3 = 5$ *and*

$x_1, x_2, x_3 \geq 0$.

17. (a) Determine an optimum assignment schedule for the following assignment problem CO2- App (16)

	1	2	3	4	5
A	-	4	7	3	4
B	4	-	6	3	4
C	7	6	-	7	5
D	3	3	7	-	7
E	4	4	5	7	-

Or

(b) Solve the Transportation problem by VAM CO2- App (16)

	*D*1	*D*2	*D*3	*D*4	*D*5	Supply
A	5	8	6	6	3	800
B	4	7	7	6	5	500
C	8	4	5	5	4	900
Demand	400	400	500	400	800	

18. (a) The demand for a computer monitor cable is Rs.1050 cables per month and shortages are allowed .If the cost per cable is Rs.125,cost of making one purchase is Rs.700, the holding cost of one cable is Rs.3 per year and cost of one shortage is Rs.50 per year ,determine the following CO3 -App (16)

i. Optimum purchase quantity
ii. Optimum number of shortages
iii. Optimum total yearly cost
iv. Number of orders per year
v. Time between order

Or

(b) Find the optimal order quantity for which the price breaks are as follows: CO3- App (16)

Quantity	Unit cost
$0 \le Q_1 \le 500$	Rs.10
$500 \le Q_2 < 750$	Rs.9.25
$750 \le Q_3$	Rs.8.75

The monthly demand for the product is 200 units, shortage cost is 2% of the unit cost and the cost of ordering is Rs.100.

19. (a) At a one – man barber shop customers arrive according to poisson distribution with a mean arrival rate of 5 per hour and his hair cutting time is exponentially distributed with an average haircut taking 10 minutes. It is assumed that because of his excellent reputation. Customers are willing to wait and calculate the following CO4 -App (16)

a)Find the average waiting time of a customer

b). Average number of customers in the shop and the average number of customers waiting for a haircut.

c) The percentage of customer who have to wait prior to getting into the barber's chair.

Or

(b) There are three typists in an office. Each typist can type an average of 6 letters per hour. If letters arrive for being typed at the rate of 15 letters per hour. Identify the Model, what fraction of time all the typists will be busy? What is the average number of letters waiting to be typed? CO4 -App (16)

20. (a) Using Dominance property Solve CO5 -App (16)

		Player B			
		B1	B2	B3	B4
Player A	A1	3	5	4	2
	A2	5	6	2	4
	A3	2	1	4	0
	A4	3	3	5	2

Or

(b) The cost of a machine is Rs.6100 and its scrap value is Rs.100. The maintenance costs found from experience are as follows: When should the machine be replaced? CO5 -App (16)

Year	1	2	3	4	5	6	7	8
Main. Cost	100	250	400	600	900	120	160	200