U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

Branch: Mechanical Engineering **Duration: 3 hrs.**

Course Code: 23ME4ESORE **Max Marks: 100**

Course: Operations Research

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	CO	PO	Marks
1	a)	What are the essential characteristics of OR? Briefly explain different phases in an OR study.	CO1	PO1	**09**
	b)	An oil company has 2 units A and B which produces 3 different grades of oil, superfine, medium and low-grade oil. The company has to supply 12, 8 and 24 barrels of superfine, medium and low-grade oils respectively per week. It costs the company Rs. 1000 and Rs. 800 per day to run the units A and B respectively. On a day unit A produces 6, 2,4 barrels and the unit B produces 2,2 and 12 barrels of superfine, medium and low-grade oil per day. The manager has to decide on how many days per week should each unit be operated in order to meet the requirement at minimum cost. Formulate the LPP and solve it graphically.	CO1	PO1	**11**
		OR			
2	a)	Define basic feasible, optimal solution, slack & surplus variables in connection with LPP.	CO1	PO1	**08**
	b)	Solve the following LP problem by simplex method. Minimize $Z = x_1-3x_2+2x_3$ Subject to $3x_1-x_2+2x_3 \leq 7$ $2x_1-4x_2 \geq -12$ $-4x_1+3x_2+8x_3 \leq 10$ $x_1, x_2, x_3 \geq 0$	CO1	PO1	**12**
		UNIT - II			
3	a)	Use Dual simplex method to solve the following LPP. Max $Z = -3x_1 - 2x_2$ Subject to $x_1 + x_2 \geq 1$ $x_1 + x_2 \leq 7$ $x_2 \leq 3$ $x_1+2x_2 \geq 10$ $x_1, x_2 \geq 0$	CO1	PO1	**10**

		b)	Find the optimal solution using the revised simplex method. Maximize $Z = 6x_1 - 2x_2 + 3x_3$ subject to $2x_1 - x_2 + 2x_3 \leq 2$ $x_1 + 4x_3 \leq 4$ and $x_1, x_2, x_3 \geq 0$	*C01*	*PO1*	**10**
			OR			
	4	a)	Solve the following LPP using Dual simplex method. Max $Z = -2x_1 - x_3$ Subject to $x_1 + x_2 - x_3 \geq 5$ $x_1 - 2x_2 + 4x_3 \geq 8$ $x_1, x_2, x_3 \geq 0$	*CO2*	*PO1* *PO2* *PO4*	**12**
		b)	Write the dual of the following LPP. Max $Z = 3x_1 + x_2 + 2x_3 - x_4$ Subject to $2x_1 - x_2 + 3x_3 + x_4 = 1$ $x_1 + x_2 - x_3 + x_4 = 3$ $x_1, x_2 \geq 0$ and x3, x4 are unrestricted in sign	*CO2*	*PO1* *PO2* *PO4*	**08**
			UNIT - III			
	5	a)	What is degeneracy in transportation problems? How it can be resolved?	*CO3*	*PO1* *PO2* *PO4*	**06**
		b)	Company has three plants at locations A, B and C which supply to ware houses located at D, E, F, G and H. Monthly plant capacities are 800,500 and 900 units respectively. Monthly warehouse requirements are 400,400,500,400 and 800 units respectively. Unit transportation costs are given below. Determine optimal distribution for the company in order to minimize the total transportation cost. (Use VAM to obtain IBFS)	*CO2*	*PO1*	**14**

To

From	D	E	F	G	H
A	5	8	6	6	3
B	4	7	7	6	5
C	8	4	6	6	4

			OR			
	6	a)	A company has 5 tasks and 5 persons to perform the same. The matrix shows the returns (profit in Rupees) in hundreds of rupees for assigning jobs to the persons. Assign the 5 tasks to 5 persons to maximize the total return.	*C03*	*PO1* *PO2*	**10**

					Person						PO4	
				Task		A	B	C	D	E		
					J1	5	11	10	12	4		
					J2	2	4	6	3	5		
					J3	3	12	5	14	6		
					J4	6	14	4	11	7		
					J5	7	9	8	12	5		
		b)	A salesman has to visit five cities A, B, C, D and E. The distance (in hundred KM) between the five cities is as follows.								C03	PO1 PO2 PO4	**10**
							To						
						A	B	C	D	E			
					A	-	7	6	8	4			
					B	7	-	8	5	6			
				From	C	6	8	-	9	7			
					D	8	5	9	-	8			
					E	4	6	7	8	-			
			If the salesman starts from the city A and has to come back to city A, which route should he select so that the total distance travelled is minimum?										
			UNIT - IV										
	7	a)	Define the following terms in connection with game theory i) Strategy ii) Game iii) Saddle point iv) Two-person zero sum game v) payoff								CO4	PO2 PO4	**05**
		b)	Use the concept of dominance to solve the following game.								CO4	PO2 PO4	**08**
							Player B						
							I	II	III	IV			
				Player A		I	6	4	8	0			
						II	6	8	4	8			
						III	8	4	8	0			
						IV	0	8	0	16			
		c)	Solve the following game by graphical method.								CO4	PO2 PO4	**07**
								B					
							I	II	III	IV	V		
				A	1		3	0	6	-1	7		
					2		1	-5	-2	2	1		
			OR										
	8	a)	There are five jobs each of which is to be processed through four machines A, B, C and D. Their processing times are given below. Determine the optimal sequence, minimum elapsed time and idle time for each machine.								CO4	PO2 PO4	**12**

			Job	**Processing time in hours**					
				A	**B**	**C**	**D**		
			1	7	15	14	21		
			2	11	18	18	6		
			3	2	13	11	16		
			4	14	4	27	14		
			5	18	11	32	16		
		b)	Use graphical method to solve the following sequencing problem, also calculate the total time required to complete both the jobs.					*CO4*	*PO2* *PO4*	**08**

Job 1	Sequence	A	B	C	D	E
	Time(hrs)	3	4	2	6	2
Job 2	Sequence	B	C	A	D	E
	Time(hrs)	5	4	3	2	6

			UNIT - V						
	9	a)	The cost of the machine is Rs 6,100 and its scrap value is Rs 100. The maintenance costs found from experience are as follows. When should the machine be replaced?					*CO5*	*PO1* *PO2*	**10**

Year	1	2	3	4	5	6	7	8
Maintenance Cost (Rs)	100	250	400	600	900	1200	1600	2000

		b)	What is replacement? What are the types of replacements? List out the benefits of Individual and group replacements?					*CO5*	*PO1* *PO2*	**10**
			OR							
	10	a)	Discuss the brief replacement procedure for the items that deteriorate with time.					*CO5*	*PO1* *PO2*	**08**
		b)	The probability of failure just before age n is shown below. If individual replacement costs Rs. 12.50 and group replacement costs Rs.3 per item (Take N_o=1000). Find the optimal replacement policy.					*CO5*	*PO1* *PO2*	**12**

n	1	2	3	4	5
Pn	.1	.2	.25	.3	.15

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