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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester : VII**

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

Course Code: 22ME7HSOPR **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)	Define i) Feasible Solution ii) Basic Feasible Solution iii) Unbound solution iv) Feasible Region v) Optimal BFS	*CO1*	*PO1* *PO2*	**10**
	b)	A farmer has 100 acre. He can sell all carrots, Lettuce or radishes he raise the price. The price he can obtain is Re 1 per kg of tomatoes, Rs 0.75 a head for lettuce and Rs 2 per kg of radishes. The average yield per acre is 2000kg tomatoes, 3000 heads of lettuce and 1000 kgs of radishes. Fertilizer is available at Rs 0.5 per kg and the amount required per acre 100 kgs each for tomatoes and lettuce, and 50 kgs for radishes. Labor required for sowing, cultivating and harvesting per acre is 5 man-days for tomatoes and radishes, 6 man-days for lettuce. A total of 400 man days of labor available at Rs 20 per man day. Formulate and solve as linear programming problem model to Maximize the farmer's total profit.	*CO1*	*PO1* *PO2* *PO3* *PO4*	**10**
		OR			
2	a)	List and explain the six phases of OR.	*CO1*	*PO1* *PO2*	**06**
	b)	Characteristics and limitations of OR	*CO1*	*PO1* *PO2*	**06**
	c)	Using graphical method, solve the following LPP Maximize $Z = 3x_1 + 5x_2$, Subjected to $x_1 + 2x_2 \leq 2000$, $x_1 + x_2 \leq 1500$, $x_2 \leq 600$ and $x_1 \geq 0$, $x_2 \geq 0$	*CO1*	*PO1* *PO2* *PO3* *PO4*	**08**
		UNIT – II			
3	a)	Use revised simplex method to solve the following LPP: Maximize $z = 3x_1 + 5x_2$ subject to $x1 \leq_4$, $x_2 \leq 6$, $3x_1 + 2x_2 \leq 18$ and x_1 , x_2 , $x_3 \geq 0$.	*CO2*	*PO1* *PO2* *PO3* *PO4*	**10**
	b)	A garment manufacturer has a production line making two styles of shirts. Style I requires 200 grams of cotton thread, 300 grams	*CO1*	*PO1* *PO2* *PO3*	**10**

			of dacron thread, and 300 grams of linen thread. Style II requires 200 grams of cotton thread, 200 grams of dacron thread and 100 grams of linen thread. The manufacturer makes a net profit of Rs. 19.50 on Style I, Rs. 15.90 on Style II. He has in hand an inventory of 24 kg of cotton thread, 26 kg of dacron thread and 22 kg of linen thread. His immediate problem is to determine, a production schedule, given the current inventory to make a maximum profit. Then he would like to know at what price it would be profitable to buy thread Solve the problem and explain how the concept of duality can be helpful to find out the right price for various kinds of thread		*PO4 PO6 PO7*	
			OR			
4	a)		Discuss the Advantages of Dual Simplex Method.	*CO2*	*PO1 PO2 PO3*	**05**
	b)		Use the Dual Simplex method to solve the following problem: Maximize $z=-2x_1-3x_2$ Subject to: $x_1+3x_2 \geq 2$ $2x_1+x_2 \leq 10$ $x_1+x_2 \leq 8$ $x1, x2 \geq 0$	*CO2*	*PO1 PO2 PO3 PO4*	**10**
4	c)		Discuss the advantages of Revised Simplex Method.	*CO2*	*PO1 PO2*	**05**
			UNIT - III			
5	a)		Consider the following transportation problem. Check IBFS by VAM method and also Find the optimum solution. TO From / A: 3, 2, 1, 15 B: 1, 2, 3, 10 C: 2, 3, 1, 14 Demand: 10, 6, 12	*CO3*	*PO1 PO2 PO3 PO4*	**10**
	b)		Find the initial basic feasible solutions for the following transportation problem by i)Northwest corner rule ii) Least cost method Determine the best optimal cost. D_1 D_2 D_3 D_4 D_5 Supply S_1: 4, 2, 3, 2, 6, 8 S_2: 5, 4, 5, 2, 1, 12 S_3: 6, 5, 4, 7, 3, 14 Demand: 4, 4, 6, 8, 8	*CO3*	*PO1 PO2 PO3 PO4*	**10**
			OR			
6	a)		The following table provides all the necessary information on the	*CO3*	*PO1*	**10**

availability of supply to each warehouse, the requirement of each market, and the unit transportation cost (in Rs) from each warehouse to each market.

		Market				
		P	Q	R	S	Supply
Warehouse	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
	Demand	7	12	17	9	

The shipping clerk of the shipping agency has worked out the following schedule, based on his own experience: 12 units from A to Q, 1 unit from A to R, 9 units from A to S, 15 units from B to R, 7 units from C to P and 1 unit from C to R.
(i) Check and see if the clerk has the optimal schedule.
(ii) Find the optimal schedule and minimum total transport cost

PO2 PO3 PO4 PO6 PO7

b) Solve the following assignment problem shown in the table using Hungarian method. — *CO3* — *PO1 PO2 PO3 PO4* — **10**

		Machine				
		I	II	III	IV	V
Job	1	9	22	58	11	19
	2	43	78	72	50	63
	3	41	28	91	37	45
	4	74	42	27	49	39
	5	36	11	57	22	25

UNIT - IV

7 a) Discuss the assumptions made in sequencing problem. — *CO4* — *PO1 PO2 PO3 PO4* — **08**

b) We have 4 jobs, each of which must go through the machines Mj (j = 1,2,….6) in the order M1,M2,…..M6. Processing time in Hours is given below. Determine the sequence of these four jobs that minimize the total elapsed time — *CO4* — *PO1 PO2 PO3 PO4 PO6 PO7* — **12**

	Machines					
	M1	M2	M3	M4	M5	M6
Job A	18	8	7	2	10	25
Job B	17	6	9	6	8	19
Job C	11	5	8	5	7	15
Job D	20	4	3	4	8	12

OR

8 a) A book binder has one printing press, one binding machine and manuscripts of 7 different books. The times required for performing printing and binding operations for different books are shown below. — *CO4* — *PO1 PO2 PO3 PO4* — **10**

Book	1	2	3	4	5	6	7
Printing time (hours)	20	90	80	20	120	15	65
Binding time (hours)	25	60	75	30	90	35	50

Determine the optimum sequence of processing of books in order to minimize the total time required to bring out all the books.

		b)	At the headquarters of Ravi Tech Solutions, there are five registration counters. Five employees are available for service. How should the counters be assigned to the employees to maximize profit? using Hungarian method. Machine Job I II III IV V 1 30 37 40 28 40 2 40 24 27 21 36 3 40 32 33 30 35 4 25 38 40 36 36 5 29 62 41 34 39	*CO4*	*PO1 PO2 PO3 PO4*	**10**
			UNIT - V			
	9	a)	Machines in a factory have increased cost as they continue in service due to increased running cost. The initial running cost is Rs 3,500 and resale price drops as time passes until it reaches a constant value of Rs 500. Determine the proper length of service before machines should be replaced. Cost data are given below. Year of Service: 1 2 3 4 5 Running Cost: 1800 2200 2700 3200 3700 Resale Value: 1900 1050 600 500 500	*CO4*	*PO1 PO2 PO3 PO4*	**10**
		b)	Suppose that the value of money is assumed to be 10% per year. Machine A is replaced after every 3 years whereas machine B is replaced after every six years. The yearly costs of the both the machines are given as under: Year : 1 2 3 4 5 6 Machine *A* 1000 200 400 1000 200 400 Machine *B* 1700 100 200 300 400 500 Determined which machine should be purchased	*CO4*	*PO1 PO2 PO3 PO4*	**10**
			OR			
	10	a)	A manufacturer offered two machines A and B. A is priced at Rs 5000 and running cost are estimated at Rs 800 for each of the first 5 years, increasing by Rs 200 per year in the 6^{th} and subsequent years. Machine B, which has the same capacity as A, costs Rs 2500 but with running cost of Rs 1200 per year for the first six years, increasing by Rs 200 per year thereafter. If money is worth 10% per year, which machine should be purchased? (Assume that the machine will eventually be sold for scrap at negligible price.)	*CO4*	*PO1 PO2 PO3 PO4*	**10**
		b)	The data collected in running a machine, the cost of which is Rs. 60,000 are given below Year: 1 2 3 4 5 Resale Value: 42000 30000 20400 14400 9650 Cost of Spares: 4000 4270 4880 5700 6800 Cost of Labour: 14000 16000 18000 21000 25000 Determine the optimum period for the replacement of the machine.	*CO4*	*PO1 PO2 PO3 PO4*	**10**

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