U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 20IM5DCOPR **Max Marks: 100**
Course: Operations Research **Date: 27.02.2023**

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) What is the objective of Operations Research (OR)? With a neat flow diagram explain various phases of OR study. **08**

b) A firm makes two products P1 & P2 and has production capacity of 18 tonnes per day. P1 & P2 require same production capacity. The firm must supply at least 4 tonnes of P1 & 6 tonnes of P2 per day. Each tonne of P1 & P2 requires 60 hours of machine work each. Maximum machine hours available are 720. Profit per tonne for P1 is Rs. 160 & P2 is Rs. 240. Find optimal solution by graphical method. **12**

OR

2 a) State any two general rules for converting primal LPP to its Dual LPP **04**

b) Solve the following LPP using Big M method. **16**

Minimize, $Z = 4x_1 + x_2$

Subject to, $3x_1 + x_2 = 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$

UNIT - II

3 a) Differentiate between assignment and transportation problems **06**

b) Determine the optimum transportation cost for the following transportation problem. Use VAM for initial feasible Solution and MODI method for optimal solution. **14**

		Unit cost (Rs) of transportation to destination				Supply units
Source		D_1	D_2	D_3	D_4	
	S_1	21	16	25	13	11
	S_2	17	18	14	23	13
	S_3	32	27	18	41	19
Demand, units		6	10	12	15	

OR

4 a) Write the algorithm for solving Travelling salesman problem **06**

b) A college is having a degree program for which the effect of semester time available is very less and the program requires field work. Hence a few hours can be saved from the total number of class hours, and can be utilized for the field work. Based on past experience, the college has estimated the number of hours required to teach each subject by each faculty. The course in its present semester has 5 subjects and the college has considered 6 existing faculty members to teach these courses. The objective is to assign the best 5 teachers out of these 6 faculty members to teach 5 different subjects so that the total number of class hours required is minimized. The data of this problem is summarized in Table. **14**

Solve assignment problem optimally.

		Subject				
		1	**2**	**3**	**4**	**5**
Faculty	**1**	30	39	31	38	40
	2	43	37	32	35	38
	3	34	41	33	41	34
	4	39	36	43	32	36
	5	32	49	35	40	37
	6	36	42	35	44	42

UNIT - III

5 a) Define Kendall's notation. Write general method for solving queuing model. **10**

b) Universal Bank is considering opening a drive-in window for customer service. Management estimates that customers will arrive at the rate of 15 per hour. The teller whom it is considering to staff the window can service customers at the rate of one every three minutes. **10**

Assuming Poisson arrivals and exponential service find

1. Average number in the waiting line.
2. Average number in the system.
3. Average waiting time in line.
4. Average waiting time in the system.

UNIT - IV

6 a) What is a project network? Distinguish between CPM and PERT techniques **06**

b) The utility data for a network are given below. Draw the project network, determine the total, free, and independent floats. Also identify the critical path and project duration. **14**

Activity	**Duration In weeks**
0-1	2
1-2	8
1-3	10
2-4	6
2-5	3
3-4	3
3-6	7
4-7	5
5-7	2
6-7	8

UNIT - V

7 a) State the dominance rules used in Game Theory. **06**

b) Solve the following 2 x 4 game and obtain the optimal strategies for players A and B. Also find the value of game. **14**

		Player B			
		I	II	III	IV
Player A	I	1	4	-2	-3
	II	2	1	4	5

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