Enrollment No._____

NAVRACHANA UNIVERSITY
a UGC recognized University

School: School of Business and Law
Program/s: MBA
Year: 1st **Semester:** 2nd
Examination: End Semester Examination
Examination year: May 2023

Course Code: OP101 **Course Name:** **Operations Research**
Date: 19/05/2023 **Total Marks:** 40
Time: 10:00 am to 12:00 pm **Total Pages:** 02

Instructions:

- *Write each answer on a new page.*
- *Use of a calculator is permitted/not permitted.*
- ** COs=Course Outcome mapping. # BTL=Bloom's Taxonomy Level mapping*

Q.1 (a) Form the dual of following primal problem: **4**

Minimize $Z = 3x_1 - x_2 + 2x_3$

Subjected to

$2x_1 - x_2 + 3x_3 = 5;$

$x_1 + x_2 - x_3 \leq 3;$

$x_1 - 4x_2 + 6x_3 \geq 12$

$x_1 \leq 0, x_2 \geq 0$ *and* x_3 *unrestricted*

(b) A company is considering for its expansion by building a new factory either in Chennai or Bangalore or perhaps even in both cities. It is also considering building at most one new warehouse. But the choice of location is restricted to a city where running factory is being built. Total capital available for investment is Rs. 15 Million. The NPV of the each alternatives are as shown below: **4** CO1, BT1, CO2, BT2, CO3 BT3, CO4 BT4

	Capital Required (in Million)	NPV (in Million)
Factory in Chennai	9	6
Factory in Bangalore	5	3
Warehouse in Chennai	4	6
Warehouse in Bangalore	3	4

Formulate the problem for the following cases:

i. Build at-least one of the two factories
ii. Build at most one of the two warehouses
iii. Can't build a warehouse unless there is a factory in the city
iv. At most one warehouse but restricted to city where factory is built

Q.2 A company has factories at F_1, F_2, and F_3 which supply to warehouses at W_1, W_2, W_3 and W_4 whose details are given below. Unit shipping costs (in rupees) are as follows. **8** CO1, BT1, CO2, BT2, CO3 BT3, CO4, BT4 CO5

Factory		Warehouse				
		W_1	W_2	W_3	W_4	Supply
	F_1	3	1	7	4	300
	F_2	2	6	5	9	400
	F_3	8	3	3	2	500
	Demand	250	350	400	200	-

Find initial feasible solution by Vogel's Approximate Method (VAM). Test the optimality by MODI method.

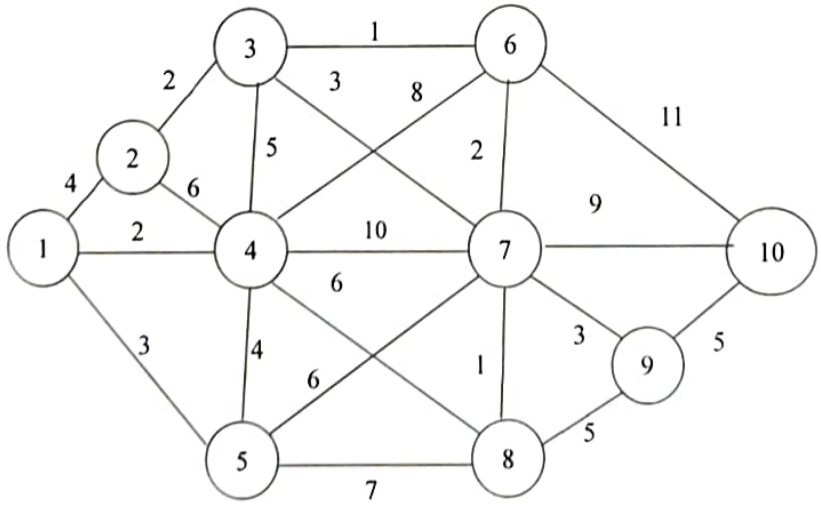
Q.3 A nutrition scheme for babies is proposed by a committee of doctors. Babies can be given two types of food (Type I and Type II) which are available in standard sized packets weighing 50 grams. The costs per packet of these foods are Rs.2/- and Rs.3/- respectively. The vitamin availability in each type of food per packet and the minimum vitamin requirement for each type of vitamin are summarized below. Develop a linear programming model to determine the optimal combination of food types with the minimum cost such that the minimum requirement of vitamin in each is satisfied. Solve the linear programming problem to minimize the cost of food using Big- M or Two phase method. **8** CO1, BT1, CO4, BT2, CO5 BT4

Vitamin	Vitamin availability per packet		Minimum daily required vitamin
	Food type I	Food type II	
A	1	1	6
B	7	1	14
Cost per packet	2	3	

Q.4 A marketing manager has 5 salesmen and 5 sales districts. Considering the capabilities of salesmen and the nature of districts, the estimates made by the marketing manager for the sales per months (in 1000 rupees) for each salesmen in each district would be as follows: **8** CO1, BT1, CO2, BT2, CO3 BT3, CO4, BT4 CO5

		Sales district				
		A	B	C	D	E
Salesmen	P	42	48	50	38	50
	Q	50	34	38	31	46
	R	51	37	43	40	47
	S	32	48	51	46	46
	T	39	43	50	45	49

Q.5 Consider the following network diagram. Find the following:
(a) Minimum spanning tree using Kruskal's algorithm. **4**
(b) Shortest distance between node 1 to node 10 using Dijkstra's algorithm. **4**



CO1, BT1, CO2, BT2, CO3 BT3, CO4, BT4 CO5

********** End of Question Paper **********