U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: VIII**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 16ME8DCORE **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

1 a) List the scope and applications of operations research. **10**

b) A manufacturing firm produces two machines parts P_1 and P_2 of a machine. For this it makes use of milling and grinding machines. The different machining times required for each part, the machining times available on different machines and then profit on each machine part as given below: **10**

Machines	Manufacturing time required(min)		Maximum time available per week(min)
	P_1	P_2	
Lathe	10	1.5	2500
Milling machine	4	10	2000
Grinding machine	1	1.5	450
Profit per unit	50	100	

Determine the number of pieces of P_1 and P_2 to be manufactured per week in order to maximize the profit.

OR

2 a) Obtain the dual of the given LPP **05**

Maximise $Z = 4x_1 + 5x_2$
Subjected to
$3x_1 + 2x_2 \leq 20$
$4x_1 - 3x_2 \geq 10$
$x_1 + x_2 = 5$
$x_1 \geq 0$, x_2 unrestricted in sign

b) Solve the following LPP by dual simplex method **15**

Min $Z = 3x_1 + 2x_2 + x_3 + 4x_4$
Subjected to
$2x_1 + 4x_2 + 5x_3 + x_4 \geq 10$
$3x_1 - x_2 + 7x_3 - 2x_4 \leq 2$
$5x_1 + 2x_2 + x_3 + 6x_4 \geq 15$
$x_1, x_2, x_3, x_4 \geq 0$

UNIT - II

3 a) A salesman has to visit five cities A, B, C, D and E. The distances (in hundred km) between the cities are as follows: **10**

From City \ To City	A	B	C	D	E
A	-	17	16	18	14
B	17	-	18	15	16
C	16	18	-	19	17
D	18	15	19	-	18
E	14	16	17	18	-

If the salesman starts from city A and has to come back to city A, which route which route should he select so that the total distance travelled by him is minimized?

b) An airline company has drawn up a new flight schedule that involves five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number out of 10. The higher the number, the greater is the preference. A few of these flights are unsuitable to some pilots, owing to domestic reasons. These have been marked with 'x'. What should be the allocation of the pilots to flights in order to meet as many preferences as possible? **10**

		Flight number				
		1	2	3	4	5
Pilot	A	8	2	X	5	4
	B	10	9	2	8	4
	C	5	4	9	6	X
	D	3	6	2	8	7
	E	5	6	10	4	3

OR

4 Debonair Private Ltd. is in the business of manufacturing and selling office shirts for men. It has four factories located in different parts of the country and the monthly capacities of the factories in thousand are as given below. The shirts are made in a few standard designs and colors, and each factory can make all types of shirts in any size subject to the overall capacity of the factory. **20**

Factories	I	II	III	IV
Monthly Capacity	3	4.5	2.5	5

From the factories, the shirts are transported to five warehouses located in five different regions in India. The warehouses in turn supply to the distributors and the retailers. The monthly demand of shirts (in thousand) from the warehouses is as follows:

Warehouses	A	B	C	D	E
Monthly Capacity	3	5	1.5	2	2.5

The cost of transporting a shirt from a factory to a warehouse depends on the distance between them and the cost of transporting a shirt from each factory to each warehouse is given in the table below. How many shirts are to be produced, in which factory, and how are these to be dispatched to the warehouse so that the total cost involved in transportation is minimized. (a) Use the North-West Corner Method to get an initial feasible solution. (b) Check if the solution obtained in (a) above is an optimal allocation and if not, then find the optimal solution.

	A	*B*	*C*	*D*	*E*	*E*
I	6	3	4	2	5	0
II	11	7	5	10	9	0
III	10	7	1	2	8	0
IV	12	10	5	3	5	0

UNIT - III

5 a) In a town there are only two discount stores ABC and XYZ stores run annual pre Diwali Sales. Sales are advertised through local newspapers with the aid of an advertising firm. ABC stores constructed following payoff in unit of Rs 100000. Find the optimal strategies for both stores and the value of the game: **10**

	Store XYZ		
Store ABC	B1	B2	B3
A1	1	-2	1
A2	-1	3	2
A3	-1	-2	3

b) Solve the following game. **10**

	B1	B2	B3
A1	1	2	2
A2	4	5	6
A3	9	-7	10
A4	-3	-4	0
A5	2	1	2

UNIT - IV

6 a) Use the graphical method to minimize the total time needed to process the following jobs on the machine shown. Also calculate the total elapsed time to complete both the jobs. **10**

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

b) A readymade garment manufacturer has to process 7 items through two stages of production viz., cutting and sewing. The time taken for each of these items at the different stages is given below in appropriate units. **10**

Item		1	2	3	4	5	6	7
Process time	Cutting	5	7	3	4	6	7	12
	Sewing	2	6	7	5	9	5	8

i. Find an order in which these items are to be produced through these stages so as to minimize the total processing time.

ii. Suppose a third stage of production is added, viz., pressing and packing, with the processing time as follows, Find an order in which these items are to be produced through these three stages so as to minimize the total processing time.

Item	1	2	3	4	5	6	7
Pressing and Packing time	10	12	11	13	12	10	11

UNIT - V

7 a) An electronic chip board contains 10000 components. When any component fails, it is replaced. The cost of replacing a component individually is Re. 1 only. If all are replaced at the same time, the cost per component would be reduced to 35 paise. The percentage of surviving components say S(t) at the end of the month t is as given below. What is the optimal replacement plan and its cost? **15**

t	0	1	2	3	4	5	6
S(t)	100	97	90	70	30	15	0

b) Explain different types of failures and the value of money. **05**

******