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: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCORE **Max Marks: 100**
Course: Operations Research **Date: 03.03.2023**

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

UNIT - I

1 a) Briefly explain various phases of OR. **06**

   b) What are the major assumptions in Linear programming? **04**

   c) The manufacture of a patent medicine processes to prepare a production plan for medicines A and B. There are sufficient ingredients to make 20,000 bottles of medicine A and 40,000 bottles of medicine B. But there are only 45,000 bottles into which either of the medicines can be filled. Further it takes 3 hours to prepare enough material to fill 1,000 bottles of medicine A and 1 hour to prepare enough material to fill 1,000 bottles of medicine B and there are 66 hours available for this operation. The profit is Rs.8/bottle for medicine A and Rs.7/bottle for medicine B. Formulate the problem as LPP. How the manufacturer schedules his production in order to maximize profit. Solve graphically. **10**

OR

2 a) Define the following: **06**
   i)   Slack variable
   ii) Surplus variable
   iii) Artificial variable

   b) Solve the following LPP by simplex method. **14**
   Max. $Z = 50x_1 + 70x_2 + 80x_3$
   Subject to, $3/2x_1 + x_2 + 12/5x_3 \leq 8$
   $x_1 + 5x_2 + x_3 \leq 12$
   $x_1, x_2, x_3 \geq 0$

UNIT - II

3 a) Write the dual of the following LPP.

Min. $Z = 2x_1 + 3x_2 + 4x_3$

Subject to, $2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 = 3$

$x_1 + 4x_2 + 6x_3 \leq 5$

$x_1, x_2 \geq 0$

x_3 unrestricted in sign

05

b) Solve the following LPP using dual simplex method.

Min. $Z = x_1 + 2x_2 + 3x_3$

Subject to, $2x_1 - x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \leq 8$

$x_2 - x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$

15

UNIT - III

4 a) What is degeneracy in transportation? How it can be resolved?

06

b) A corporation has three manufacturing plants 1,2 and 3 which can produce one or all the four different products A,B,C and D. Different variable costs at each plant result in variable unit profit as given in the following table. The capacity of each plant and the demand for each product are also given. Determine the quantity of products that should be manufactured at each plant so that total profit is maximized. Find basic feasible solution by Vogel's approximation method.

14

Product \ Plant	A	B	C	D	Capacity Units/week
1	22	26	20	21	450
2	21	24	20	19	300
3	18	20	19	20	250
Demand	200	300	150	270	920 \ 1000

OR

5 a) Consider the following problem of assigning five operators to five machines. The assignment costs are given in the table. Operator A cannot be assigned to machine 3 and operator C cannot be assigned to machine 4. Determine the optimum assignment schedule and the corresponding assignment costs.

10

Machine

	1	2	3	4	5
A	5	5	--	2	6
B	7	4	2	3	4
C	9	3	5	--	3
D	7	2	6	7	2
E	6	5	7	9	1

Operator is on the left spanning the rows A–E.

b) Solve the following traveling salesman problem given the following data. **10**
$C_{12} = 20$, $C_{13} = 4$, $C_{14} = 10$, $C_{23} = 5$, $C_{34} = 6$, $C_{25} = 10$, $C_{35} = 6$, $C_{45} = 20$
Where, $C_{ij} = C_{ji}$ and there is no route between cities i and j if a value for C_{ij} is not given.

UNIT - IV

6 a) Solve the following game. **10**

Player B

		I	II	III
Player A	**I**	-4	6	3
	II	-3	-3	4
	III	2	-3	4

b) Find the sequence that minimizes the total time required in performing the **10** following jobs on three machines in the order C, B, A. Also find the total elapsed time.

Job

		1	2	3	4	5	6
Machine	**A**	8	7	6	9	10	9
	B	3	4	5	2	1	6
	C	8	3	7	2	5	1

UNIT - V

7 a) What are the situations which make the replacement of items necessary? **06**

b) The cost of machine is Rs.6,100 and its scrap value is Rs.100. At the end of **14** every year, the maintenance charges(MC) found from experience are as follows:

Year	1	2	3	4	5	6	7	8
MC	100	250	400	600	900	1200	1600	2000

When the machine is to be replaced?

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