M/E/TX

Reg. No: 22BME0483.

VIT
Vellore Institute of Technology

Final Assessment Test – May 2024

Course: **BMEE215L - Engineering Optimization**

Class NBR(s): **4643 / 4645 / 4649 / 4651 / 4652** Slot: **C1+TC1+TCC1**

Time: **Three Hours** Max. Marks: **100**

- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instructions:

i. **Standard normal distribution table is permitted.**
ii. **All steps in the answer need to be shown.**

Answer any FIVE Questions

(5 X 20 = 100 Marks)

1. a) A company has three operational departments (weaving, processing and packing) with the capacity to produce three different types of clothes namely suitings, shirtings and woollens yielding the profit of Rs 2, Rs 4 and Rs 3 per metre respectively. One metre suiting requires 3 minutes in weaving, 2 minutes in processing and 1 minute in packing. One metre of shirting requires 4 minutes in weaving, 1 minutes in processing and 3 minutes in packing, while one metre woollen requires 3 minutes in each department. In a week, total run time of each department is 60, 40 and 80 hours of weaving, processing and packing departments respectively. Formulate the LPP to find the product mix to maximize the profit. **[5]**

   b) Solve the given LPP using Big M method **[15]**

   Max $Z=x_1 - x_2 + 3x_3$

   subject to

   $x_1+x_2 \leq 20$

   $x_1+ x_3 = 5$

   $x_2 + x_3 \geq 10$

   $x_1, x_2, x_3 \geq 0$

2. a) A team of 5 horses and 5 riders has entered a jumping show contest. The number of penalty points to be expected when each rider rides any horse is shown below. **[5]**

	R1	R2	R3	R4	R5
H1	5	3	4	7	1
H2	2	3	7	6	5
H3	4	1	5	2	4
H4	6	8	1	2	3
H5	4	2	5	7	1

Find optimal solution as one rider rides only one horse so that the total penalty points is minimized.

b) Solve the following transportation problem for initial basic feasible solution using Vogel's approximation method. Find the optimal solution using MODI Method. [15]

	Destination Centre				
	D1	**D2**	**D3**	**D4**	**Capacity**
S1	3	1	7	4	**300**
S2	2	6	5	9	**400**
S3	8	3	3	2	**500**
Requirement	**250**	**350**	**400**	**200**	

3. a) A research and development department is developing a new power supply for a console television set. It has broken the job down into the following. **[10]**

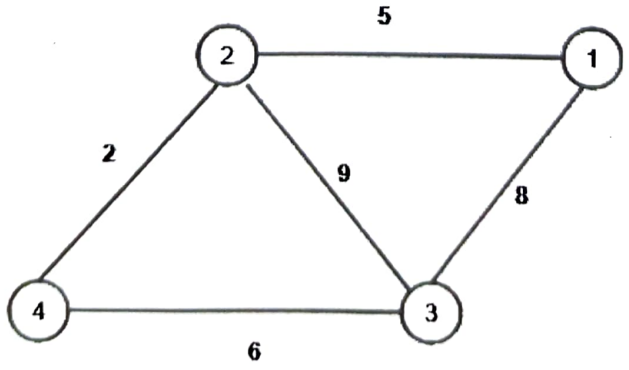
Job	Preceding Job	Time (in Days)
A	-	5
B	A	7
C	B	2
D	B	3
E	C	1
F	D	2
G	C	1
H	E,F	3
I	G,H	10

i. Construct the network diagram.

ii. Determine the critical path and length of the project.

iii. What is the implication of activity E, if its duration is increased by 2 days?

b) The Tell-All mobile-phone company services four geographical areas. The satellite distances (in miles) among the four areas are shown in the figure given below. Decide the most efficient message routes (shortest routes) that should be established between each two areas in the network. **[10]**



4. A contractor estimates that the size of the work force needed over the next 5 weeks is 5,7,8,4 and 6 workers, respectively. Excess labour kept on the force will cost \$300 per worker per week, and new hiring in any week will incur a fixed cost of \$400 plus \$200 per worker per week. Assume firing cost is negligible, and minimum workforce requirement is always met. Using dynamic programming, construct the backward recursive equation for the problem and find the number of labours per week, such that the total cost of the labour needed for the project is minimized. **[20]**

5. a) Find $X = (x_1, x_2)$ which minimize **[10]**

$$f(X) = x_1^3 + 2x_1^2 - 10x_1 + x_2^2 - 5x_2$$

subject to the constraints

$$x_1 + x_2 \leq 2$$

$$x_1, x_2 \geq 0$$

using Karush Kuhn–Tucker conditions.

b) Consider the following non-linear constrained optimization problem **[10]**

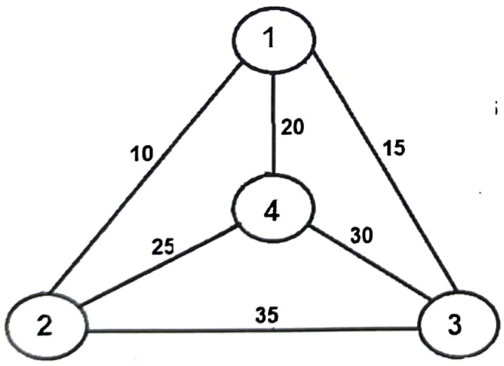
$$\text{Min } f(x_1, x_2) = \frac{1}{3}(x_1 + 1)^3 + x_2$$

subject to $-x_1 + 1 \leq 0$

$$-x_2 \leq 0$$

Find the solution of the problem after performing six iterations of interior penalty function method with initial value of penalty parameter is 100 and its subsequent values are based on c = 0.1.

6. Using Genetic Algorithm (GA), describe the steps followed to solve a travelling salesman problem(TSP) as shown in the figure below. **[20]**



Find the minimum value of total cost of the route between a subset of the cities. Assume suitable and appropriate parameter values of the algorithm considering the population size of 5. Perform hand computation for one complete iteration.

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