Activity	Preceding Activities	Activity Duration (Days)
A	------	4
B	------	7
C	------	6
D	A, B	5
E	A, B	7
F	C, D, E	6
G	C, D, E	5

(a) Draw the network and find the project completion time.

(b) Calculate total float for each of the activities and highlight the critical path. **15**

6. Solve the non-linear programming problem :

Optimize $Z = x_1^2 + 2x_2^2 + 1.5x_3^2$

Subject to the constraints :

$$2x_1 + 2x_2 + 3x_3 = 30$$
$$3x_1 - 4x_2 + 4x_3 = 25$$
$$x_1, x_2, x_3 \geq 0$$ **15**

Section D

7. (a) Find the extremals of the functional $\int_{x_0}^{x_1} \left(\frac{y'^2}{x^3} \right) dx$. **7**

MAR-21-210043

B. Tech. EXAMINATION, March 2021

Semester IV (CBCS)

OPTIMIZATION AND CALCULUS OF VARIATIONS

(CE, ME, AE, ECE, EE, EEE, CSE, IT)

MA-401

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from each Sections A, B, C and D. All questions carry equal marks.

Section A

1. (a) Define the following : **6**

(i) General statement of Linear Programming Problem

(ii) Assumption of Linear Programming.

(b) Explain the terms :

(i) Non-Negativity Constraint

(ii) Extreme Point

(iii) Basic Feasible Solution. **9**

2. Use Simplex method to solve the following LPP :

Maximize $Z = 45x_1 + 80x_2$

Subject to the conditions :

$$5x_1 + 20x_2 \leq 400$$
$$10x_1 + 15x_2 \leq 450$$
$$x_1, x_2 \geq 0$$ **15**

Section B

3. A company wishes to assign 3 jobs to 3 machines in such a way that each job is assigned to some machine and no machine works on more than one job. The cost of assigning job (i) to machine (j) is given by the matrix below (ijth entry) : cost matrix $\begin{bmatrix} 8 & 7 & 6 \\ 5 & 7 & 8 \\ 6 & 8 & 7 \end{bmatrix}$.

Draw the associated network. Formulate the network LPP and find the minimum cost of making the assignment. **15**

4. A company has three cement factories located in cities 1, 2, 3 which supply cement to four projects located in towns 1, 2, 3, 4. Each plant can supply 6, 1, 10 truck loads of cement daily respectively and the daily cement requirements of the projects are respectively 7, 5, 3, 2 truck loads. The transport costs per truck load of cement (in hundreds of rupees) from each plant to each project site are as follows :

		Project sites			
		1	2	3	4
	1	2	3	11	7
Factories	2	1	0	6	1
	3	5	8	15	9

Determine the optimal distribution for the company so as to minimize the total transportation cost. **15**

Section C

5. A small project consists of seven activities for which the relevant data are given ahead :

(b) Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which when rotated about the x-axis gives a minimum surface area. **8**

8. (a) Prove that the sphere is the solid figure of revolution which, for a given surface area, has maximum volume. **7**

(b) Prove that geodesics on a right circular cylinder of radius a. **8**

9. (i) Define Balanced transport problem.

(ii) Define optimization problems.

(iii) State Bellman's optimality principle.

(iv) Define convexity.

(v) Define Euler Lagrange's equation.

(vi) Define gradient method.

(vii) Define isoperimetric problem.

(viii) Define degenerate solution.

(ix) Define surplus variables.

(x) Define extremum. **10×1.5=15**

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