Subject to constraints :

$$x_1 + x_2 \leq 5,$$

where $x_1, x_2 \geq 0.$ **10**

**Section D**

**7.** (a) Find extremals for $\int_{x_0}^{x_1} \frac{1+y^2}{y'^2} dx$. **5**

(b) Find the extremals of the functional

$J[y(x)] = \int_1^2 \frac{x^3}{y'^2} dx$, where $y(1) = 0$, $y(2) = 3$.

**5**

**8.** (a) Find the extremals of the functional

$J[y(x)] = \int_1^2 yy''^3 dx$, where $y(0) = 0$,

$y(1) = 1$. **5**

(b) Derive the Euler's equation $\frac{\partial F}{\partial y} - \frac{d}{dx}\left(\frac{\partial F}{\partial y'}\right) = 0$,

for functional containing first order derivatives and one independent variable. **5**



**Roll No.** ..... **Total Pages : 05**

# July-22-00247

## B. Tech. EXAMINATION, 2022

Semester IV (CBCS)

OPTIMIZATION AND CALCULUS OF VARIATIONS

MA-401

(Common for B. Tech. All Branches)

*Time : 3 Hours* *Maximum Marks : 60*

*The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.*

**Note** : Attempt *Five* questions in all, selecting *one* question from each Section A, B, C and D. Q. No. **9** is compulsory.

**Section A**

**1.** Explain the concept of duality in linear programming. Point out various useful aspects of the concept. **10**

**2.** Define the following : **10**

(i) Feasible solution

(ii) Optimal solution

(iii) Slack variable

(iv) Surplus variable.

## Section B

**3.** Solve the following problem by Simplex method :

Maximize : $Z = 6x_1 + 8x_2$

Subject to constraints :

$$30x_1 + 20x_2 \leq 300$$

$$5x_1 + 10x_2 \leq 110$$

where $x_1, x_2 \geq 0$. **10**

**4.** (a) Solve the following transportation problem by NWCM. Find difference between the cost obtained from NWCM : **5**

| | W1 | W2 | W3 | W4 | Supply |
|---|---|---|---|---|---|
| F1 | 20 | 25 | 40 | 20 | 100 |
| F2 | 29 | 26 | 35 | 40 | 250 |
| F3 | 31 | 33 | 37 | 30 | 150 |
| Demand | 90 | 160 | 200 | 50 | 500/500 |



(b) Solve the transportation by VOGEL's approximation method : **5**

| | P | Q | R | S | Supply |
|---|---|---|---|---|---|
| A | 11 | 13 | 17 | 14 | 250 |
| B | 16 | 18 | 14 | 10 | 300 |
| C | 21 | 24 | 13 | 10 | 400 |
| Demand | 200 | 225 | 275 | 250 | |

## Section C

**5.** Use the method of Lagrangian multipliers to solve the following :

Minimize : $Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$

Subject to constraints :

$$x_1 + x_2 + x_3 = 20$$

where $x_1, x_2, x_3 \geq 0$. **10**

**6.** What are Kuhn-Tucker conditions for non-linear programming problems ? Formulate these conditions for the problem :

Maximize : $f(x) = \log (x_1 + x_2)$

**(Compulsory Question)**

**9.** (i) Define PERT.

(ii) Define an unbalanced assignment problem.

(iii) When a transportation problem is called unbalanced ?

(iv) Explain Initial Basic feasible solution.

(v) What is degeneracy in transportation problem ?

(vi) What is the full form of CPM ?

(vii) Define Feasible solution.

(viii) Define extremals.

(ix) Write Euler's equation for extremals when F is independent of $x$.

(x) Define convex function. **10×2=20**