Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2722012 **Date: 31/05/2016**

Subject Name: Structural Optimization

Time:10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 Formulate the problem for minimum weight in terms of optimization statement and solve it graphically. A cantilever PCC beam of length of 1.5 m subjected to point load of 10 kN/m at the tip of beam. Maximum deflection should not be more than span/300 mm. E = 22000 MPa. Width of beam should not be less than 150 mm. **14**

Q.2 (a) Explain the terms: Objective function, constraint surface and design vector. **07**

(b) Explain the terms: Relative minimum and maximum. Also state the necessary and sufficient condition for relative minimum of a single variable function. **07**

OR

(b) Locate the stationary points of function f(x) and classify them as relative maxima, relative minima or neither. **07**

$$f(x) = \frac{2x_1^3}{3} + 2x_1x_2 - 5x_1 + 2x_2^2 + 4x_2 + 5$$

Q.3 (a) Classify the stationary points as maxima, minima and neither. **10**

$$f(x) = -x_1^2 - x_2^2 - x_3^2 + 2x_1x_2 + 2x_1x_3 + 4x_1 - 5x_3 + 2$$

(b) Explain Kuhn Tucker conditions. **04**

OR

Q.3 (a) Minimize the function using Langrange multiplier method. **10**

$$f(x) = -3x_1^2 - 6x_1x_2 - 5x_2^2 + 7x_1 + 5x_2 \quad \text{subject to}$$

$$x_1 + x_2 = 5$$

(b) Explain the term: canonical form with taking simple example. **04**

Q.4 Using Kuhn Tucker conditions, solve the problem. **14**

$$f(x) = x_1^2 + x_2^2 + 60x_1 \quad \text{subject to the constraints}$$

$$g_1 = x_1 - 80 \geq 0 \quad and\ g_2 = x_1 + x_2 - 120 \geq 0$$

OR

Q.4 Using simplex method, solve the problem. **14**

$$Maximize\ f(x) = x_1 + 2x_2 + x_3 \quad subject\ to$$

$$2x_1 + x_2 - x_3 \leq 2$$

$$2x_1 - x_2 + 5x_3 \leq 6$$

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

$$x_1, \quad x_2, \quad x_3 \geq 0$$

Q.5 Formulate the objective function and constraints for the portal frame shown in figure (1) by using plastic method and obtain its solution. **14**

OR

Q.5 (a) Explain the genetic algorithm. Also state use in the optimization. **07**

(b) State the various methods of nonlinear programming problem for optimization. Elaborate any one in detail. **07**

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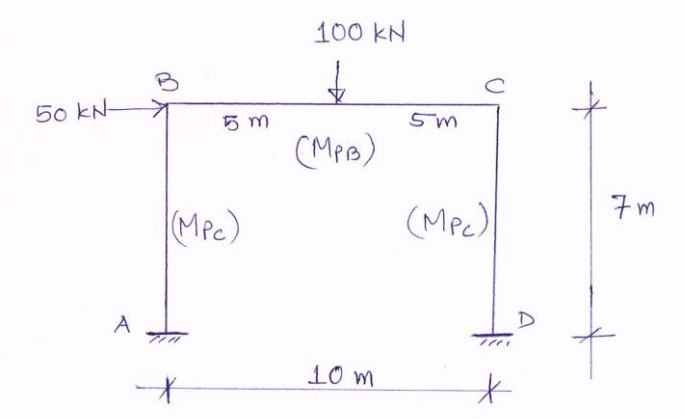

Fig. 1 (Q.5)