

GUJARAT TECHNOLOGICAL UNIVERSITY
ME - SEMESTER-II • EXAMINATION – SUMMER - 2017

Subject Code: 2722012**Date: 30/05/2017****Subject Name: Structural Optimization****Time: 02:30 PM To 05:00 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 simply supported PCC beam of length of 4.5 m subjected to point load of 25 kN/m at the center of beam. Maximum deflection should not be more than span/350 mm. $E = 22500$ MPa. Width of beam should not be less than 200 mm. **14**
- Q.2 (a)** Write in short on “Design Constrains”. **07**
- (b)** The ultimate strength attained by the concrete is found to be based on a certain empirical relationship between the ratios of cement and concrete used. The basic objective is to maximize the strength attained by the hardened concrete given by the function $f(x)$. Here x_1 and x_2 are two variables based on the cement and concrete used. **07**
- $$f(x) = 20 + 2x_1 - x_1^2 + 6x_2 + \frac{3x_2^2}{2}$$
- OR**
- (b)** Find the optimum value of the function $f(x)$ and states if the function attains maximum or minimum. **07**
- $$f(x) = x^2 + 3x - 5$$
- Q.3 (a)** Find the dimensions of cylindrical tin with top and bottom made up of sheet metal to maximize its volume such that the total surface are equals to 24π , using Lagrange Multiplier Method **10**
- (b)** Explain the term: canonical form with taking simple example. **04**
- OR**
- Q.3 (a)** Maximize the function $f(x, y) = 2x + 3y$ subject to $g(x, y) = x^2 + y^2 \leq 2$, using any method of optimization. **10**
- (b)** Write the basic equation of Lagrange Multiplier method. **04**
- Q.4** Using Kuhn Tucker conditions, solve the problem. **14**
- $$f(x, y, z) = x.y.z \text{ subject to } g_1 = x^2 + y^2 \leq 1 \text{ and } g_2 = x + z \geq 1.$$
- OR**
- Q.4** Using simplex method, solve the problem. **14**
- Maximize the $Z = 2x_1 - x_2 + 2x_3$ subject to
- $$2x_1 + x_2 \leq 10, x_1 + 2x_2 - 2x_3 \leq 20 \text{ and } x_2 + 2x_3 \leq 5$$
- 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

Formulate the objective function and constraints for the truss shown in figure (2) by using any method and obtain its solution. The horizontal and vertical displacement at joint D is restricted to 4 mm. Stress in members are limited to $1 \times 10^6 \text{ kN/mm}^2$. Length of each member is same 'L'.

14

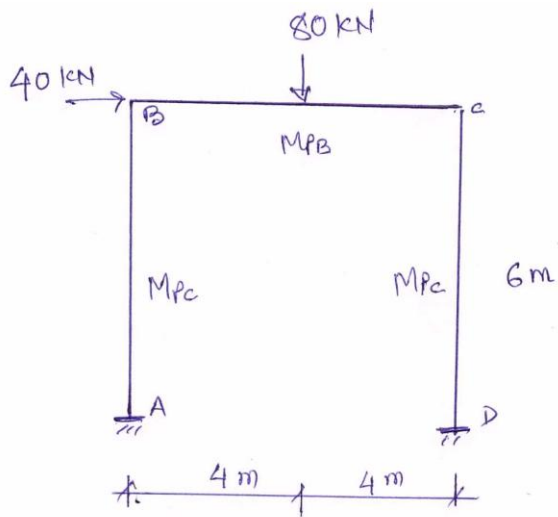


Fig. 1 (Q.5)

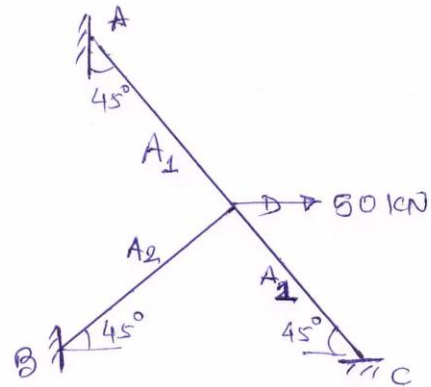


Fig. 2 (OR Q.5)