Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**ME - SEMESTER–IV • EXAMINATION – SUMMER • 2014**

**Subject Code: 741501** **Date: 04-06-2014**

**Subject Name: Structural Optimization**

**Time: 02:30 pm - 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 cantilever beam of length of 1.5 m for minimum weight subjected to deflection of beam should not exceed span/350. Density of PCC is 24 kN/m$^3$ and E = 20000 MPa. Also obtain the solution for the problem, with the assumption that width of beam should not exceed 150mm. | **14** |
| **Q.2** | **(a)** | Explain the relative maxima and relative minima with necessary sketches. | **07** |
| | **(b)** | Explain on ñObjective functionò and ñDesign Constraintò | **07** |
| | | **OR** | |
| | **(b)** | Explain the terms with sketch: Free Point, Bound Acceptable Point and Feasible Region. | **07** |
| **Q.3** | **(a)** | A beam of uniform rectangular cross section is to be cut from a log having a circular c/s of diameter 2a. The beam has to be used as a cantilever beam to carry a concentrated load at free end. Find the dimensions of the beam that corresponds to the maximum bending stress carrying capacity. | **10** |
| | **(b)** | Explain the concavity and convexity of the function. | **04** |
| | | **OR** | |
| **Q.3** | **(a)** | Minimize $f(x) = x_1^2 + x_2^2 + x_3^2$<br>Subject to<br>$x_1 + x_2 + x_3 \geq 5$<br>$2 - x_2 x_3 \leq 0$<br>$x_1 > 0, x_2 > 0, x_3 > 2$<br>Determine whether the Kuhn-Tucker conditions are satisfied at the following points.<br>$x_1 = \begin{Bmatrix} \frac{3}{2} \\ \frac{3}{2} \\ 2 \end{Bmatrix}, x_2 = \begin{Bmatrix} \frac{4}{3} \\ \frac{2}{3} \\ 3 \end{Bmatrix}, \quad = \begin{Bmatrix} 2 \\ 1 \\ 2 \end{Bmatrix}$ | **10** |
| | **(b)** | Explain Lagrange Multiplier technique. | **04** |

**Q.4** Design a pin jointed steel frame shown in fig.1 for minimum weight. The horizontal deflection is limited to 2.5mm and vertical deflection is limited to 4mm. The allowable stress in each member is limited to 160MPa. **14**

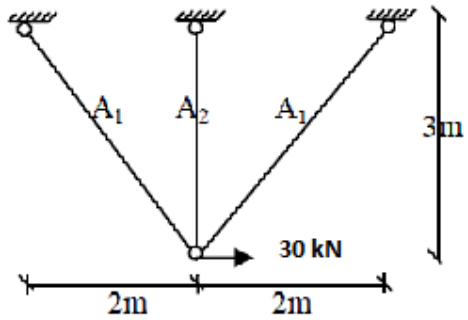


**Fig. 1**

**OR**

**Q.4** Design the portal frame shown in fig .2 for minimum cost, if permissible horizontal sway in frame is 5mm and bending stress in members is 140 MPa **14**

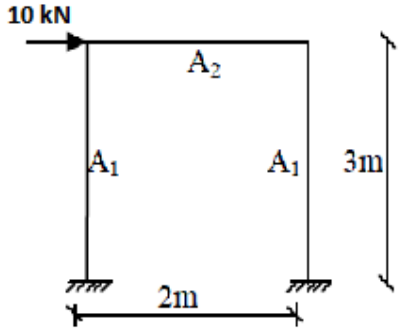


**Fig. 2**

**Q.5** **(a)** Minimize the function given below using graphical method. **10**

$f = 5x_1 - x_2$ subjected to

$x_1 + x_2$ Ó2

$x_1 + 2x_2$ Ò2

$2x_1 + x_2$ Ò2

$x_1, x_2$ Ó0

**(b)** Explain the significance of optimization. **04**

**OR**

**Q.5** **(a)** Use simplex method to minimize **10**

$f = 5x_1 + 3x_2 + x_3$ subjected to

$2x_1 + x_2 + x_3$ Ò3

$-x_1 + 2x_3$ Ò4

$x_1, x_2, x_3$ Ó0

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

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