Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. – SEMESTER – IV EXAMINATION – OCTOBER 2012

Subject code: 741501 Date: 25-10-2012

Subject Name: Structural Optimization

Time: 2:30 pm – 5:00 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 **(a)** Explain Stationary points, relative and global optimum points for a function. **07**

(b) Enlist and describe briefly "Advanced Techniques for Optimization". **07**

Q.2 **(a)** Explain Concave and Convex function for single and two variables with their properties. **07**

(b) Determine the critical points and locate any relative minima, maxima and saddle points of function f defined by $f(x , y) = 2x^2 + 2xy + 2y^2 - 6x$. **07**

OR

(b) Considering the function, $f(x) = 12x^2 - 45x^4 + 40x^3 + 5$, locate the stationary points and find out if the function is convex, concave or neither at the points of optima based on the testing rules. **07**

Q.3 **(a)** Maximizing the function $f(x, y, z) = xyz$ subject to the constraints, **07**
$g_1(x, y, z) = x + y + z = 1$ and $g_2(x, y, z) = x + y - z = 0$.
(Geometrically, each of these constraints is a plane and considering them simultaneously means considering their intersection, which will be a line).

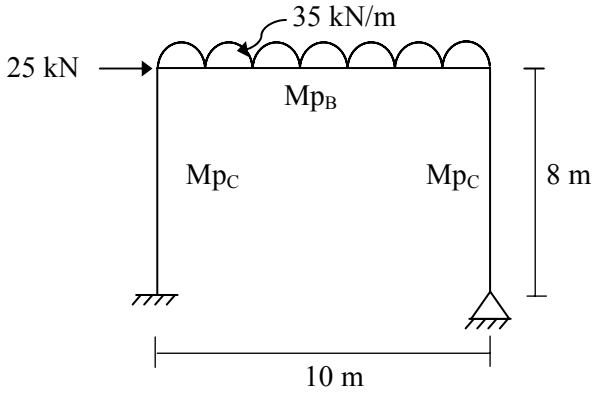
(b) Using Kuhn Tucker's condition maximize a function $f(x_1, x_2) = 4x_1 + 3x_2$ subject to $g(x_1, x_2) = 2x_1 + x_2 \leq 10$ and $x_1, x_2 \geq 0$. **07**

OR

Q.3 **(a)** Use simplex method to maximize, **07**
$P = 3x + 4y$ subject to: $x + y \leq 4$, $2x + y \leq 5$, $x \geq 0$, $y \geq 0$

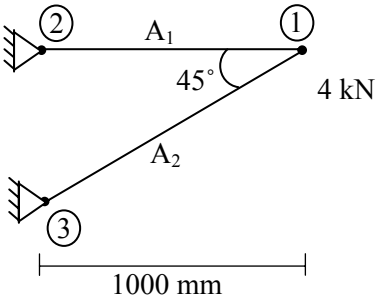
(b) Derive Kuhn Tucker's condition to maximize **07**
$f(x_1, x_2) = 12x_1^2 - 8x_2$ Subject to:
$4x_1 + x_2 = 16$, $x_1^2 + x_2^2 \leq 11.4$, $3x + y \leq 18$, $x_1 \geq 0$

Q.4 Formulate constraint equations & objective function for following structure using plastic method. Obtain solution for minimum weight by graphical method. **14**

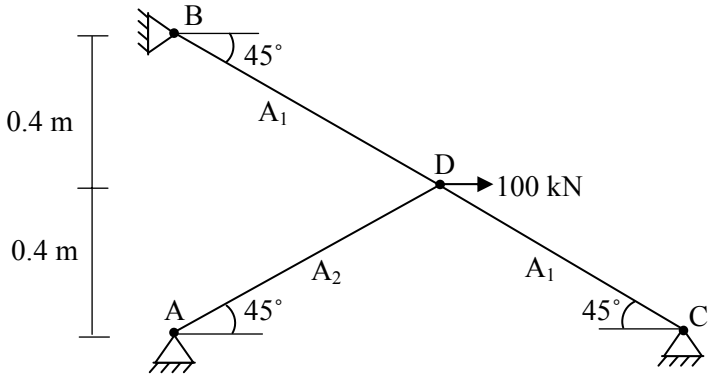


OR

Q.4 Design a following statically determinate pin jointed truss structure using force or displacement method. Take: $E = 200$ kN/mm^2, $\sigma_t = 0.15$ kN/mm^2, $\sigma_c = 0.15$ kN/mm^2, $\delta_{at\,1} = 6$ mm. **14**



Q.5 Design the following pin jointed statically determinate truss structure for minimum weight. The horizontal and vertical deflections at joint D are both limited to 5 mm and the numerical value of stress in any member is limited to 1.3×10^6 kN/m^2. Use matrix force or displacement method. **14**



OR

Q.5 Design the following fixed based portal frame structure for minimum volume. The permissible sway is 5 mm and permissible bending stress is 0.21 kN/mm^2. Use matrix force or displacement method. Axial deformation may be neglected. **14**