Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E -IVth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 741501 Date: 12/05/2012

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 **(a)** Discuss in details: **07**
(1) Function (2) Variables (3) Constraints

(b) Enlist various engineering applications of optimization. **07**

Q.2 **(a)** Define "Saddle Point". Also explain characteristic with respect to one and two variables. **07**

(b) Analyze the function, $f(x) = 12x^2 - 45x^4 + 40x^3 + 5$ and classify the stationary points as maxima, minima and points of inflection. **07**

OR

(b) Considering the function, $f(x) = 2x_1^3/3 - 2\,x_1x_2 - 5x_1 + 2x_2^2 + 4x_2 + 5$, find out if the function is convex, concave or neither at the points of optima based on the testing rules. **07**

Q.3 **(a)** Use the method of Lagrange multipliers to maximize the function $f = x^3y^5$ subjected to the constraint $x + y = 8$. **07**

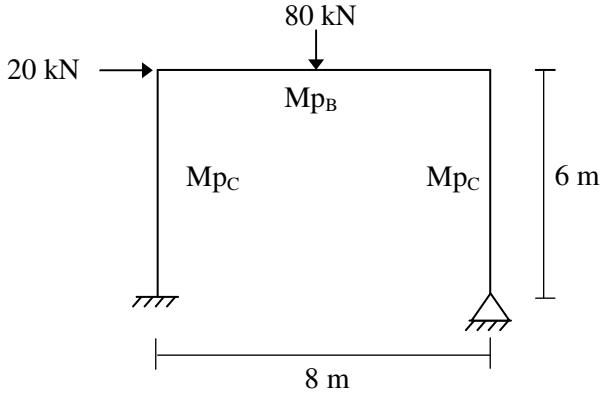
(b) Minimize $f = x_1^2 + 2x_2^2 + 3x_3^2$ subjected to the constraints, **07**
$g_1 = x_1 - x_2 - 2x_3 \leq 42$
$g_1 = x_1 + 2x_2 - 3x_3 \leq 8$ Using Kuhn Tucker's condition.

OR

Q.3 **(a)** Use simplex method to minimize, **07**
$Z = f(x, y) = 3x + 2y$ Subject to:
$2x + y \leq 18$, $2x + 3y \leq 42$, $3x + y \leq 24$, $x \geq 0$, $y \geq 0$

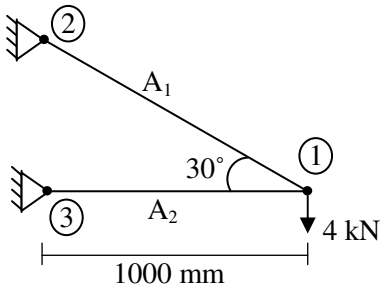
(b) Derive Kuhn Tucker's condition to maximize **07**
$f(x_1, x_2) = 6x_1^2 - 4x_2$ Subject to:
$2\,x_1 + x_2 = 8$, $x_1^2 + x_2^2 \leq 19.4$, $3x + y \leq 24$, $x_1 \geq 0$

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

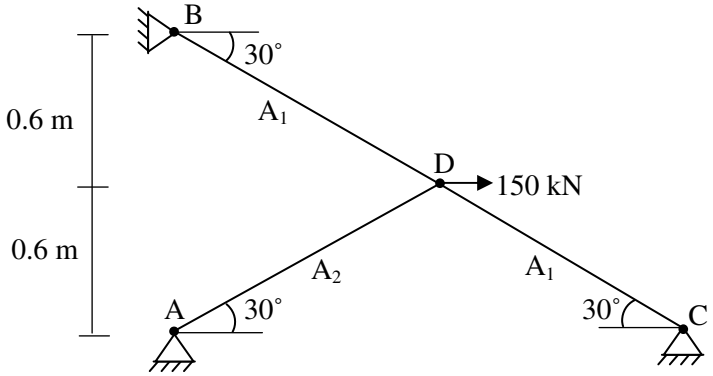


OR

Q.4 Design a following statically determinate pin jointed truss structure using force or displacement method. Take: E = 200 kN/mm^2, σ_t = 0.15 kN/mm^2, σ_c = 0.10 kN/mm^2, $\delta_{at\ 1}$ = 4 mm. **14**

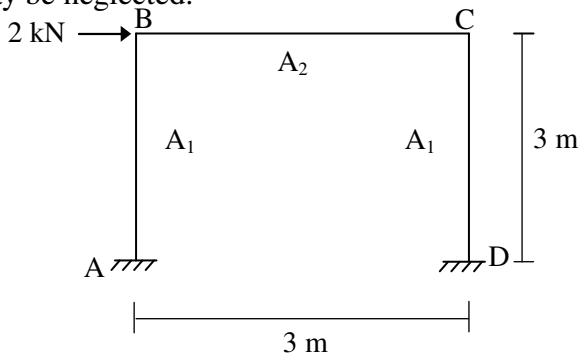


Q.5 Design the following pin jointed statically determinate truss structure for minimum weight. The horizontal and vertical deflections at joint D are both limited to 5 mm and the numerical value of stress in any member is limited to 1.2 × 10^6 kN/m^2. Use matrix force or displacement method. **14**



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 0.15 kN/mm^2. Use matrix force or displacement method. Axial deformation may be neglected. **14**



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