Z 6403

DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Elective

Structural Engineering

ST 1631 — OPTIMIZATION IN STRUCTURAL DESIGN

(Regulation 2005)

Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a merit function?

2. What are inactive constraints?

3. Under what conditions dynamic programming will be successful?

4. What are the classical methods of optimization?

5. Compare search and elimination methods.

6. Explain fully stressed design.

7. Differentiate univariate and multivariate minimization.

8. What are the advantages of linear programming?

9. Explain Fibonacci series.

10. What is meant by hyper plane?

PART B — (5 × 16 = 80 marks)

11. (a) Minimize $f(x)=\frac{1}{2}\left(x_1^2+x_2^2+x_3^2\right)$

subject to $g_1(x)=x_1-x_2=0$

$g_2(x)=x_1+x_2+x_{3-1}=0$

by direct substitution method.

Or

(b) Explain optimization technique by the method of Lagrange multipliers with an example.

12. (a) Solve the following LP problem using simplex method :

Maximize $f=-2x_1-x_2+5x_3$

subject to $x_1-2x_2+x_3\le 8$

$3x_1-2x_2\ge -18$

$2x_1+x_2-2x_3\le -4.$

Or

(b) A box column is to carry an axial load of 500 kN. Permissible compressive stress of the material of the column is 30 MPa. The maximum size of the column is restricted to 300 mm and its wall thickness shall not exceed 15 mm. Form the optimization problem and find its solution.

13. (a) Solve the following LP problem by dynamic programming :

Maximize $f(x)=10x_1+8x_2$

subject to

$2x_1+x_2\le 25$

$3x_1+2x_2\le 45$

$x_2\le 10$

$x_1\ge 0,\ x_2\ge 0.$

Or

(b) Three cities A, B and C are to be connected by a gas pipe line. The distances between A and B, B and C and C and A are 5, 3 and 4 respectively. The following restrictions are to be restricted by the pipe line :

(i) the pipes leading out of A should have a total capacity of atleast 3.

(ii) the pipes leading out of B or of C should have total capacities of either 2 or 3 and

(iii) no pipe between any two cities must have a capacity exceeding 2.

Only pipes of an integer number of capacity units are available and the cost of pipe is proportional to its capacity and length. Determine the pipe capacities to minimize cost.

(a) Minimize $f(x) = (x_1 - 1)^2 + (x_2 - 5)^2$

Subject to $-x_1^2 + x_2 \leq 4$

$-(x_1 - 2)^2 + x_2 \leq 3$

starting from the point $X_1 = \begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$ and use interior penalty function method.

Or

(b) Find the plastic moment capacities of the portal frame shown in Fig. 1 for minimum weight.

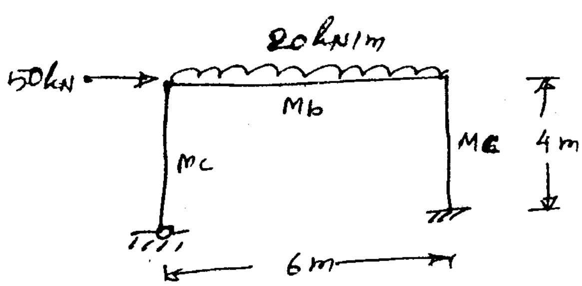

Fig. 1

15. (a) Minimize $f(x) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$

from the starting point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using any search method.

Or

(b) Minimize $f(x) = 4x_1^2 + 3x_2^2 - 5x_1x_2 - 8x_1$, starting from the point (0, 0) by Newton's method.
