No. of Printed Pages : 4

BICEE-004

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

00226

June, 2015

BICEE-004 : STRUCTURAL OPTIMIZATION

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions. Use of scientific calculator is permitted. Assume any missing data.*

1. (a) What do you understand by a design space in optimization problem ? 5

(b) State the linear programming problem in standard form (either scalar or matrix form). 5

2. (a) Develop objective function and design constraints for a minimum-weight design of a prismatic beam as shown in the figure, subject to a limitation on the maximum deflection. 5

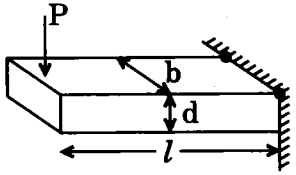

Figure 1

(b) State the limitations of Fibonacci method. 5

3. A light metal industry manufactures two products A and B. Each product must pass through two processing sections L and M. A good number of machines are available in both sections. Product A requires 2 hours of processing time in L and 1 hour in M. Product B requires 1 hour of processing time in L and 4 hours in M. Total time available in section L is 6,000 hours, whereas in M it is 10,000 hours. The net profit for product A is ₹ 10 per unit and for B is ₹ 15 per unit. Formulate this problem as a linear programming model to maximize profit per week. *10*

4. (a) Describe the distinction between a local minimum and local maximum in unconstrained optimization problem. *5*

(b) The total profit (in rupees) of a beam manufacturing firm (of standard length) from manufacturing and sale of a particular number of beams is given by

$$y = -(x^2/400) + 2x - 80,$$

where y is the total profit (in rupees) and x is the number of beams.

What is the profit per beam when a number of beams are sold to get maximum profit ? *5*

5. (a) Briefly explain the reasons behind the use of partial derivatives while optimizing a multivariable function. *3*

(b) Consider the function,

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

Determine the maximum or minimum point (if any) of the function. *7*

6. (a) State the Kuhn-Tucker necessary conditions for constrained multivariable optimization problem. *3*

(b) Find the optimum value of the objective function subject to given constraints mentioned as under : *7*

Maximize $z = 10x_1 - x_1^2 + 10x_2 - x^2$

subject to,

$$x_1 + x_2 \leq 14$$

$$-x_1 + x_2 \leq 6$$

$$x_1, x_2 \geq 0.$$

7. (a) Explain 'Grid Search Method'. *5*

(b) Describe the various steps used in the 'Steepest Descent Method'. *5*

8. (a) What do you understand by 'Interpolation Method' in multi-variable optimization technique ? *3*

(b) Derive the one-dimensional minimization problem for the following case : *7*

Minimize $f(X) = (x_1^2 - x_2)^2 + (1 - x_1)^2$

from the starting point $X_1 = \begin{Bmatrix} -2 \\ -2 \end{Bmatrix}$ along the search direction $S = \begin{Bmatrix} 1{\cdot}00 \\ 0{\cdot}25 \end{Bmatrix}$.

9. (a) Define the following dynamic programming terms : *5*

(i) State variable

(ii) Decision variable

(b) Use dynamic programming to solve the following linear programming problem : *5*

Maximize $z = 3x_1 + 5x_2$

subject to,

$$x_1 \leq 4$$

$$x_2 \leq 6$$

$$3x_1 + 2x_2 \leq 18 ;$$

$$x_1, x_2 \geq 0.$$

10. Write short notes on any ***two*** of the following : *10*

(a) Random Jumping Method

(b) Interior Penalty Function Method

(c) Design Constraints in the Construction of Water Dam