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BICEE-004

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

December, 2015

BICEE-004 : STRUCTURAL OPTIMIZATION

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **seven** out of ten questions. Use of scientific calculator is permitted. Assume missing data suitably, if any. All questions carry equal marks.*

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1. Use graphical method to solve the Linear Programming Problem :

$$\text{Max } z = 4x_1 + 3x_2$$

subject to constraints

$$2x_1 + x_2 \leq 1000$$

$$x_1 + x_2 \leq 800$$

$$x_1 \leq 400$$

$$x_2 \leq 700$$

$$x_1 \geq 0, x_2 \geq 0.$$

10

2. (a) Differentiate between Linear and Non-Linear Programming Problems. *3*

(b) Find the maximum and minimum of

$$f(x) = x^3 - 6x^2 + 9x + 1$$

on the interval [0, 5]. 7

3. The manager of an oil refinery wants to decide on the optimal mix of two possible blending processes 1 and 2 of which the inputs and outputs of the production run are as follows :

Input (Units)			Output (Units)	
Process	Crude A	Crude B	Gasoline X	Gasoline Y
1	5	3	5	8
2	4	5	4	4

The maximum amounts available of crudes A and B are 200 units and 150 units respectively. At least 100 units of Gasoline X and 80 units of Gasoline Y are required. The profits per production run from process 1 and 2 are ₹ 300 and ₹ 400 respectively. Formulate the above as a Linear Programming Problem. 10

4. (a) Obtain the set of necessary conditions for the Non-Linear Programming Problem.

$$\text{Max } z = x_1^2 + 3x_2^2 + 5x_3^2$$

subject to the conditions

$$x_1 + x_2 + 3x_3 = 2$$

$$5x_1 + 2x_2 + x_3 = 5$$

where $x_1, x_2, x_3 \geq 0$. 6

(b) Explain the significance of the study of problems of optimization of function, when constraints are placed on the variables. 4

5. Write the Kuhn-Tucker conditions for the following problem and determine the unknowns x_1, x_2 and x_3, so as to

$$\text{Max } z = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$$

subject to the constraints

$$x_1 + x_2 \leq 2$$

$$2x_1 + 3x_2 \leq 12$$

$$x_1, x_2 \geq 0.$$

10

6. Use cubic search method to find the point of minima of the function

$$f(x) = x^2 + \frac{54}{x} \text{ in the interval}$$

$$0 \leq x \leq 3.$$

10

7. Use dynamic programming to solve the LPP

$$\text{Max } z = x_1 + 9x_2$$

subject to the constraints

$$2x_1 + x_2 \leq 25$$

$$x_2 \leq 11$$

$$x_1, x_2 \geq 0.$$

10

8. Minimize

$$f(x) = 7x_1 x_2^{-1} + 3x_2 x_3^{-2} + 5x_1^{-3} x_2 x_3 + x_1 x_2 x_3$$

$x_1, x_2, x_3 \geq 0$ using the geometric programming method. *10*

9. Solve the quadratic programming problem

$$\text{Max } z = 2x_1 + x_2 - x_1^2$$

subject to

$$2x_1 + 3x_2 \leq 6$$

$$2x_1 + x_2 \leq 4$$

$$x_1, x_2 \geq 0.$$ *10*

10. Write the dual of LPP

$$\text{Min } z = 4x_1 + 6x_2 + 18x_3$$

subject to the constraints

$$x_1 + 3x_2 \geq 3$$

$$x_2 + 2x_3 \geq 5$$

$$x_1, x_2, x_3 \geq 0.$$ *10*