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BICEE-004

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

00093

December, 2016

BICEE-004 : STRUCTURAL OPTIMIZATION

Time : 3 hours *Maximum Marks : 70*

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

1. (a) Briefly explain concave and convex functions of a single variable. *5*

(b) Describe any four applications of structural optimization. *5*

2. A manufacturing company is engaged in producing three types of products, A, B and C. The production department produces, each day, components sufficient to make 50 units of A, 25 units of B and 30 units of C. The management is confronted with the problem of optimizing the daily production of the products in the assembly department, where only 100 man-hours are available daily for assembling the products. The following additional information is available :

Type of products	Profit contribution per unit of product (₹)	Assembly Time per product (hrs)
A	12	0·8
B	20	1·7
C	45	2·5

The company has a daily order commitment for 20 units of product A and a total of 15 units of products B and C. Formulate the problem as a linear programming model so as to maximize the total profits. *10*

3. Solve the following non-linear programming problem :

Minimize

$$f(x) = 5x_1^{1}x_2^{-1} + 2x_1^{-1}x_2^{1} + 5x_1^{1}x_2^{0} + x_1^{0}x_2^{-1}$$

using the geometric programming method. (Assume $n > m + 1$) *10*

4. (a) Express the mathematical form of Quadratic programming problem. *6*

(b) Write any two applications of Quadratic programming. *4*

5. Determine x_1 and x_2 so as to

Maximize $z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$

subject to the constraints

$x_1 \leq 8;$

$x_1 + x_2 \leq 10;$

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

6. A firm has a total revenue function $R = 20x - 2x^2$, and a total cost function $C = x^2 - 4x + 20$, where x represents the quantity. Find the revenue maximizing output level and the corresponding value of profit, price and total revenue. *10*

7. Find the second order Taylor's series approximation of the function

$$f(x_1, x_2) = x_1^2 \cdot x_2 + 5x_1 \cdot e^{x_2}$$

about the point $x_0 = [-1, 0]^T$. *10*

8. Use dynamic programming to solve the following linear programming problem : *10*

Maximize $z = 3x_1 + 5x_2$

subject to the constraints

$x_1 \leq 4;$

$x_2 \geq 6;$

$3x_1 + 2x_2 \leq 18$ and

$x_1, x_2 \geq 0.$

9. (a) What do you mean by slack and surplus variables in linear programming problem ? *4*

(b) Obtain the dual of the following primal LP problem : *6*

Maximize $z = x_1 - 2x_2 + 3x_3$

subject to

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

$$2x_1 + 3x_2 + 4x_3 = 1$$

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

10. (a) What do you mean by Genetic Algorithm ? What are the building block hypotheses of genetic algorithm ? *4*

(b) Explain in brief, Crossover and Mutation genetic algorithm. *6*