No. of Printed Pages : 4

BICEE-004

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

00467

June, 2016

BICEE-004 : STRUCTURAL OPTIMIZATION

Time : 3 hours *Maximum Marks : 70*

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

---

1. Use graphical method to solve the linear programming problem

   Maximize $z = 50x_1 + 60x_2$,

   subject to the constraints :

   $2x_1 + 3x_2 \leq 1500$,

   $3x_1 + 2x_2 \leq 1500$,

   $0 \leq x_1 \leq 400, 0 \leq x_2 \leq 400$. *10*

2. (a) What do you mean by optimization ? Explain the different phases of optimization. *3*

   (b) Find the maximum and minimum value of the function

   $f(x) = x^5 - 5x^4 + 5x^3 - 1$. *7*

3. A firm can manufacture three types of cloth namely A, B and C. Three types of wool are required for it — red, green and blue. One unit length of type A cloth needs 2 yards of red wool and 3 yards of blue wool, one unit length of type B cloth needs 3 yards of red, 2 yards of green, and 4 yards of blue wool, while 1 unit length of C-type cloth needs 5 yards of green wool and 4 yards of blue wool. The firm has a stock of 8 yards of red wool, 10 yards of green wool and 15 yards of blue wool. The income obtained by the firm from one unit length of cloth of type A is ₹ 3, of the type B is ₹ 5 and that of the type C is ₹ 4. How should the firm allocate the available material so as to maximize total income from the finished cloth ? Formulate the linear programming problem. *10*

4. (a) Obtain the set of necessary conditions for the non-linear programming problem :

Optimize $z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1 x_2$

subject to the constraints

$$x_1 + x_2 + x_3 = 15$$

$$2x_1 - x_2 + 2x_3 = 20.$$ *7*

(b) Define convex and concave functions. Also characterize them by partial derivatives. *3*

5. Write the Kuhn-Tucker conditions for the following minimization problem :

Minimize $f(x) = x_1^2 + x_2^2 + x_3^2$,

subject to the constraints

$g_1(x) = 2x_1 + x_2 \le 5$

$g_2(x) = x_1 + x_3 \le 2$

$g_3(x) = -x_1 \le -1$

$g_4(x) = -x_2 \le -2$

$g_5(x) = -x_3 \le 0.$ *10*

6. Find the point of minima of $x^3 - 3x + 2$, in the interval $0 \le x \le 3$, using quadratic interpolation method. *10*

7. Solve the following linear programming problem by dynamic programming approach :

Maximize $z = 2x_1 + 5x_2$,

subject to the constraints

$2x_1 + x_2 \le 43$,

$2x_2 \le 46$ and

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

8. Solve the following problem by geometric programming :

Minimize

$$f(x) = 16x_1 x_2 x_3 + 4x_1 x_2^{-1} + 2x_2 x_3^{-2} + 8x_1^{-3} x_3$$

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

9. Solve the following problem :

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

subject to the constraints

$x_1 + 4x_2 \leq 4,$

$x_1 + x_2 \leq 2,$

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

10. Formulate the dual of the following linear programming :

Maximize $z = 5x_1 + 3x_2$

subject to the constraints

$3x_1 + 5x_2 \leq 15,$

$5x_1 + 2x_2 \leq 10,$

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