No. of Printed Pages : 3 **BICEE-004**

# B.Tech. CIVIL ENGINEERING (BTCLEVI)

## Term-End Examination

00703 **June, 2018**

## 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.*

1. Define 'Linear programming'. What are the advantages and limitations of linear programming approach ? *10*

2. A company produces two types of leather belts, type A and type B. Belt A is of superior quality and belt B is of lower quality. Profits on the two types of belts are ₹ 40 and ₹ 30 per belt respectively. Each belt of type A requires twice as much time as required by a belt of type B. If all belts were of type B, the company would produce 1000 belts per day. Belt A requires a fancy buckle and 400 fancy buckles are available for this per day. For belt of type B, only 700 buckles are available per day. Formulate Linear Programming Problem model to determine the number of belts of the two types to be manufactured to get maximum profit. *10*

3. Solve the following non-linear programming problem by Lagrange multiplier method. *10*

Opt. $f(x) = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$

s.t. $x_1 + x_2 + x_3 = 20$

$x_1, x_2, x_3 \geqslant 0$

4. Using Steepest Descent method, find the minimum of the function

$$f(x_1, x_2) = x_1^2 - x_1 x_2 + x_2^2$$

so that the error does not exceed by 0·05. The initial approximation is to be taken as (1, 1/2). *10*

5. Find the number of experiments to be conducted to reduce the interval of uncertainty to $0{\cdot}001\ L_0$ ($L_0$ : initial interval of uncertainty) for any ***two*** of the following : *10*

(a) Bolzano search

(b) Dichotomous search with $\delta = 0{\cdot}0001$

(c) Fibonacci search

(d) Golden search

6. Using the dynamic programming, find the minimum of the sum of squares of those numbers whose product is 27. *10*

7. Use dynamic programming to solve LPP 10

Maximize $z = x_1 + 9x_2$

$$\text{s.t. } 2x_1 + x_2 \leqslant 25$$

$$x_1 \leqslant 11$$

$$x_1, x_2 \geqslant 0$$

8. Find the lower bound for 10

$$f(x) = x^{-4} + 4x^3 + 4x, \quad x > 0.$$

9. Determine the optimal pipe diameter for the minimum installed plus operating costs for L metres of pipe conveying a given flow rate of water. The installed cost in rupees is $C_1 \times D$, and the lifetime pumping cost in rupees in $\frac{C_2 \times 10^5}{D^5}$.

The diameter D is in metres. 10

10. Determine the value of $u_1$, $u_2$, and $u_3$, so as to maximize $(u_1 \cdot u_2 \cdot u_3)$, subject to

$$u_1 + u_2 + u_3 = 10$$

and $u_1, u_2, u_3 \geqslant 0$,

by using dynamic programming. 10