

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

June, 2015

00696

**BICEE-021 : COMPUTATIONAL METHODS IN
STRUCTURAL ENGINEERING**

Time : 3 hours

Maximum Marks : 70

Note : Attempt any five questions. All questions carry equal marks. Use of calculator is permitted.

1. (a) Write a note on Matrix inversion technique based on Cholesky decomposition. 7
- (b) Discuss in detail the utility and application of the principle of virtual work in Structural Analysis. 7
2. Check whether the point $(-2, -2, 4)$ is a local minimum of the problem : 14

$$f = x_1 + x_2 + x_3$$

$$g_1 = 8 - x_1^2 - x_2^2$$

$$g_2 = x_3 - 4$$

$$g_3 = x_2 + 8$$

$$g_1, g_2, g_3 \geq 0$$

3. Differentiate between sizing, shape and topology optimisation of structures. 14
4. (a) Write a short note on convergence criteria for iterative methods. 7
- (b) Write a note on perturbation and sensitivity analysis. 7

5. Consider a problem of the form

$$\text{Minimize } f_0(\mathbf{x}) / (\mathbf{c}^T \mathbf{x} + d)$$

$$\text{subject to } f_i(\mathbf{x}) \leq 0, \quad i = 1, \dots, n$$

$$\Delta \mathbf{x} = \mathbf{b}$$

where, f_0, f_1, \dots, f_n are convex and the domain of the objective function is defined as

$$\{\mathbf{x} \in \text{dom } f_0 \mid \mathbf{c}^T \mathbf{x} + d > 0\}.$$

For this, show that this is a quasiconvex optimisation problem. 14

6. Solve the following set of equations by Gauss elimination method : 14

$$-3y + 7z = 2$$

$$x + 2y - z = 3$$

$$5x - 2y = 2$$

7. Find the minimum of

$$f = -x_1^3 - 2x_2^2 + 10x_1 - 6 - 2x_2^3$$

subject to

$$g_1 = 10 - x_1x_2$$

$$g_2 = x_1$$

$$g_3 = 10 - x_2$$

$$g_1, g_2, g_3 \geq 0$$

The Kuhn-Tucker conditions are

$$-3x_1^2 + 10 + \lambda_1x_2 - \lambda_2 = 0$$

$$-4x_2 - 6x_2^2 + \lambda_1x_1 + \lambda_3 = 0.$$

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