Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013**

**Subject code: 715004N** **Date: 30-12-2013**

**Subject Name: Optimization Methods for Engineering Systems**

**Time: 10.30 am – 01.00 pm** **Total Marks: 70**

## Instructions:

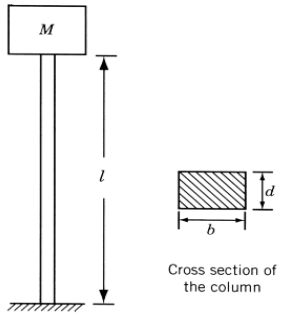
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** What is Engineering Optimization? Enlist the different applications of Optimization Methods in Engineering. **07**

**(b)** (i) Define Objective function with appropriate example. **03**

(ii) Define Constrained and Unconstrained optimization problems. **04**

**Q.2** **(a)** A uniform column of rectangular cross section is to be constructed for supporting a water tank of mass M (Fig). It is required (1) to minimize the mass of the column for economy, and (2) to maximize the natural frequency of transverse vibration of the system for avoiding possible resonance due to wind. Formulate the problem of designing the column to avoid failure due to direct compression and buckling. Assume the permissible compressive stress to be $\sigma_{max}$. **07**




**(b)** Maximize $f = -X_1^2 - X_2^2 + 4X_1 + 4X_2 - 8$ **07**

subject to $X_1 + 2X_2 \leq 4$

$2X_1 + X_2 \leq 5$

Using Kuhn-Tucker conditions.

**OR**

**(b)** Explain necessary and sufficiency condition for single variable optimization techniques. **07**

**Q.3** **(a)** Find the minimum of the function $f(\lambda) = 0.65 - [(0.75)/(1+\lambda^2)] - 0.65\,\lambda\tan^{-1}(1/\lambda)$ using Newton-Raphson method with starting point $\lambda_1 = 0.1$ and use $\epsilon = 0.01$ for checking the convergence. **07**

**(b)** Minimize the function $f(x) = 0.65 - [0.75/(1 + x^2)] - 0.65\,x\tan^{-1}(1/x)$ in the interval [0,3] using the Fibonacci method with n = 6. **07**

**OR**

**Q.3** **(a)** Find the minimum of $f = \lambda^5 - 5\lambda^3 - 20\lambda + 5$ by the cubic interpolation method. **07**

**(b)** Minimize the function $f(x) = 0.65 - [0.75/(1 + x^2)] - 0.65\,x\tan^{-1}(1/x)$ by the golden section method using with n = 6. **07**

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|---|---|---|---|
| **Q.4** | **(a)** | Elucidate in detail the different characteristics of a constrained optimization problems. | **07** |
| | **(b)** | Minimize the following function using Univariate method of optimization. With starting point (0,0) $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.4** | **(a)** | Explain the iterative procedure of Fletcher – Reeves method. | **07** |
| | **(b)** | Explain the Steepest descent method of unconstrained optimization methods in detail. | **07** |
| **Q.5** | **(a)** | Explain the basic approach of the interior penalty function method with algorithm. | **07** |
| | **(b)** | Define Integer programing problem and explain gomory's cutting plane method. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Explain the basic approach of the exterior penalty function method with algorithm. | **07** |
| | **(b)** | Explain dynamic programming approach of optimization and enlighten the concept of sub-optimization and principle of optimality. | **07** |

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