Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014**

**Subject Code: 725407** **Date: 25-06-2014**

**Subject Name: Advanced Optimization Techniques**

**Time: 02:30 pm - 05:00 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)** ( i ) Find the extreme values of the function **03**

$$f(x) = 2x^3 - 9x^2 + 12x.$$

( ii ) Find the extreme values of the function **04**

$$f(x,y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x.$$

**(b)** Use Simplex Method to minimize the function **07**

$$f = -x_1 - 2x_2 - x_3$$

subject to

$$2x_1 + x_2 - x_3 \le 2,$$
$$2x_1 - x_2 + 5x_3 \le 6,$$
$$4x_1 + x_2 + x_3 \le 6,$$
$$x_i \ge 0, \qquad i = 1 \; to \; 3.$$

**Q.2** **(a)** Use Dichotomous Search Method to find the minimum of the function **07**

$$f(x) = 0.65 - \frac{0.75}{1+x^2} - 0.65\, x\, tan^{-1}\left(\frac{1}{x}\right)$$

in the interval $(0, 3)$ to achieve an accuracy of within 5% of the exact value using a value of $\delta = 0.001$.

**(b)** Find the minimum of the function $f(\lambda) = \lambda^5 - 5\lambda^3 - 20\lambda + 5$ by Golden Section Method in the interval $(0, 5)$ with $n = 6$. **07**

**OR**

**(b)** Find the minimum of the function **07**

$$f(\lambda) = \frac{0.5}{\sqrt{1+\lambda^2}} - \sqrt{1+\lambda^2}\left(1 - \frac{0.5}{1+\lambda^2}\right) + \lambda$$

using the Newton-Raphson method with the starting point $\lambda_1 = 0.7$. Use $\varepsilon = 0.01$.

**Q.3** **(a)** ( i ) Write the algorithm of interior penalty function method. **03**

( ii ) Write the algorithm of Sequential Linear Programming. **04**

**(b)** Perform two iterations of Fletcher-Reeves method to minimize the function $4x_1^2 + 3x_2^2 - 20x_1 - 26x_2 - 4x_1x_2$ starting from the point $X_1 = [0, 0]^T$. **07**

**OR**

**Q.3** **(a)** Use Powell's method to minimize the function **07**

$$f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + 2x_2^2$$

from the starting point $X_1 = [0, 0]^T$.

**(b)** Perform two iterations of the Newton's method to minimize the function $f(x_1, x_2) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$ from the starting point $X_1 = [-1.2, 1.0]^T$. **07**

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| **Q.4** | **(a)** | Describe the encoding methods used in Genetic Algorithm. What is a fitness function? Explain in detail the operators used in Genetic Algorithm. | **07** |
| | **(b)** | Describe the basic Particle Swarm Optimization algorithm. What is the local best model of PSO? | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Write the basic procedure of Differential Evolution Algorithm. Also, write about some of variants. | **07** |
| | **(b)** | Write the QPSO algorithm. Also write about some of its variants. | **07** |
| **Q.5** | **(a)** | Write the basic Ant Colony Optimization Algorithm. | **07** |
| | **(b)** | Give an example of a constrained nonlinear optimization problem. Also describe how you will apply any one of the evolutionary algorithms to solve that problem. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | What are memetic algorithms? Why they have to be used? | **07** |
| | **(b)** | Write a short note on performance measures used in differential evolution algorithm. What are control parameters in differential evolution algorithm? | **07** |

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