Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (OLD) EXAMINATION – WINTER 2016

Subject Code: 714704 Date:22/11/2016

Subject Name: Optimization Theory and Practice

Time:10:30 Am to 1:00 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 company produces three products P_1, P_2 and P_3 from two raw materials A and B and labour L. one unit of product P_1 requires one unit of A, 3 units of B and 2 units of L. One unit of product P_2 requires 2 units of A and B each, and 3 units of L, while one unit of P_3 needs 2 units of A, 6 units of B and 4 units of L. The company has a daily availability of 8 units of A, 12 units of B and 12 units of L. It is further known that the unit contribution margin for the products is ₹ 3, ₹ 2 and ₹ 5 respectively for P_1, P_2 and P_3. Formulate this problem as a linear programming problem, and then solve it to determine the optimum product mix. Is the solution obtained by you unique? Identify the alternate optimum solution, if any. **14**

Q:2 **(a)** Explain the Particle Swam Optimization Technique. **07**

(b) How is the crossover operation performed in Genetic Algorithms (GA)? What is the purpose of mutation? How is it implemented in GA? **07**

OR

(b) Explain the random jumping method and grid search method used to optimize nonlinear unconstrained problem. **07**

Q:3 **(a)** A beam of uniform rectangular cross section is to be cut from a log having a circular cross section of diameter *2a*. The beam has to be used as a cantilever beam to carry a concentrated load at the free end. Find the dimensions of the beam that correspond to maximum bending stress carrying capacity. The bending stress (σ) induced at any fiber located at distance y from neutral axis is given by $\frac{\sigma}{y} = \frac{M}{I}$. **07**

(b) Explain the Lagrange multipliers method to determine solution of two variables and one constraint. Also explain the necessary and sufficient conditions **07**

OR

Q:3 **(a)** Find the dimensions of a cylindrical tin(with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 24\pi$. Use Lagrange multiplier method. **07**

(b) Discuss the necessary and sufficient conditions for single variable optimization problem. Find the maximum and minimum values of the function: **07**

$$f(x) = 12x^5 - 45x^4 + 40x^3 + 5$$

Q:4 **(a)** Suppose f (x, y) = 2x + 3y subject to g(x, y) = $x^2 + y^2 \leq 2$ show that f and g satisfy the Kuhn Tucker sufficiency conditions and hence find the maxima of f (x, y). **07**

(b)
1. What is a unimodal function? **02**
2. What is an interval of uncertainty? **01**
3. Find the minimum of f(x) = x(x-1.5) in interval (0.0 1.0) to within 10% of exact value using exhaustive search method. **04**

OR

Q:4 **(a)** Minimize $f(x) = x^2 + x - 2\sqrt{x}$ in interval (0,2) using golden section method. Take n = 6. **07**

(b) Minimize $f(x) = x^2 + \frac{54}{x}$ in interval (0,5) using interval halving method. Take n = 6. **07**

Q:5 **(a)** Explain the transformation technique of constrained optimization. **07**

(b) Minimize f (x_1, x_2) = $x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ with starting point (0, 0) using univariate method of optimization. **07**

OR

Q:5 **(a)** Find the minimum of function $f(x) = 7x - \ln(x)$ using Newton's method for accuracy of 0.001 and initial value $x_1 = 0.1$. **07**

(b) Discuss various steps of the Hooke and Jeeves' method of unconstrained optimization. **07**

****