M.Sc. Engg./ Ph.D.

December 23, 2023
1:30 pm – 4:30 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 6413
Course Title: Engineering Optimization

Winter Semester, A. Y. 2022-2023
Time: 3 Hours
Full Marks: 150

There are **7 (Seven)** questions. Answer any **5 (Five)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question are written in the brackets.

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1. a) Formulate the method of Lagrange multiplier for problems with equality constraint for a simple case of two variables and one constraint. Expand the formulation to explain the necessary condition for a general problem. **13**

   b) Minimize the following objective function subjected to the given constraints by applying Lagrange multiplier method. **17**

$$Minimize\ f = 9 - 8x_1 - 6x_2 - 4x_3 + 2x_1^2 + 2x_2^2 + x_3^2 + 2x_1x_2 + 2x_1x_3$$

Subject to

$$x_1 + x_2 + 2x_3 = 3$$

2. a) Specify the difference between Lagrange Multiplier method and Kuhn-Tucker Conditions. **5**

   b) Minimize the following objective function subjected to the given constraints by applying Kuhn-Tucker conditions. **25**

$$Minimize\ f = (x_1 - 1)^2 + (x_2 - 5)^2$$

Subject to

$$-x_1^2 + x_2 \leq 4$$
$$-(x_1 - 2)^2 + x_2 \leq 3$$

3. a) Find all the basic solutions corresponding to the system of equations and identify whether solutions are feasible or not, optimal or not and degenerative or not. **15**

$$2x_1 + 3x_2 - 2x_3 - 7x_4 = 1$$
$$x_1 + x_2 + x_3 + 3x_4 = 6$$
$$x_1 - x_2 + x_3 + 5x_4 = 4$$

   b) Solve the following linear programming problem using simplex method. **15**

$$Maximize\ f = x_1 + 2x_2 + x_3$$

Subject to

$$2x_1 + x_2 - x_3 \leq 2$$
$$-2x_1 + x_2 - 5x_3 \geq -6$$
$$4x_1 + x_2 + x_3 \leq 6$$
$$x_i \geq 0, \quad i = 1, 2, 3$$

4. a) Define a unimodal and multimodal function with suitable diagram. **5**

b) Find the value of x in the interval (0, 1) which minimizes the function $f = x(x - 1.5)$ to within ± 0.05 by (i) the Dichotomous and (ii) the Fibonacci method. **25**

5. Find the minimum of the following function by using the secant method. **30**

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

6. Minimize $f = 2x_1^2 + x_2^2$ from the starting point (1, 2) using univariate method (Two cycles only) **30**

7. a) Minimize $f = 4x_1^2 + 3x_2^2 - 5x_1x_2 - 8x_1$ by using the steepest descent method with the starting point (0, 0) (three iterations only) **15**

b) Minimize $f = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ by taking the starting point (0, 0) using Newton's method. **15**