

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2017-2018

DURATION: 1 Hour 30 Minutes

FULL MARKS: 75

Math 4641: Numerical Methods

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

1. a) While solving a mathematical model using numerical methods, how can we use relative approximate errors to minimize the error? 5
 b) What do you understand by truncation error? Find out the truncation error of e^x using seven terms of Maclaurin series. Your error should be calculated up to four significant digits. 8
 c) Given that $f(3) = 6$, $f'(3) = 8$, $f''(3) = 12$ and that all other higher order derivatives of $f(x)$ are zero at $x = 3$, and assuming the function and all its derivatives exist and are continuous between $x = 3$ and $x = 7$. Find out the value of $f(7)$. 12

2. a) Explain the differences between interpolation and regression with appropriate example. 4
 b) A company advertises that every box of chocolate has at least 250 chocolates. The probability that there are 250 or more chocolates in the box is given by 14

$$P(y \geq 250) = \int_{250}^{\infty} 0.3515 e^{-0.3881(y-252.2)^2} dy$$
 Approximating the above integral as

$$P(y \geq 250) = \int_{250}^{270} 0.3515 e^{-0.3881(y-252.2)^2} dy$$
 - i. Use single segment Trapezoidal rule to find the probability that there are 250 or more chocolates in a single box.
 - ii. Find the true error, E , for part (i).
 - iii. Find the absolute relative true error for part (i).
 c) Derive the trapezoidal rule of Integration from Calculus. 7

3. a) Mention the limitations of bisection method with appropriate example. 6
 b) You are working for a start-up computer assembly company and have been asked to determine the minimum number of computers that the shop will have to sell to make a profit. The equation that gives the minimum number of computers to be sold after considering the total costs and the total sales is 13

$$f(n) = 40n^{1.5} - 875n + 35000 = 0$$

Use the Newton-Raphson method of finding roots of equations to find the minimum number of computers that need to be sold to make a profit. Conduct three iterations to estimate the root of the above equations. Also find the absolute relative approximate error at the end of each iteration.

- c) Which method is better between Newton-Raphson and Secant method for finding out the root of a non-linear equation? Justify your answer with appropriate reason. 6

4. a) A robot arm with a rapid laser scanner is doing a quick quality check on holes drilled in a 15"x10" rectangular plate. The centers of the holes in the plate describe the path the arm needs to take, and the hole centers are located on a Cartesian coordinate system (with the origin at the bottom left corner of the plate) given by the specifications in Table 1. 12

Table 1: Dataset for Question 4.(a)

X (in)	Y (in)
2.00	7.2
4.25	7.1
5.25	6.0
7.81	5.0
9.20	3.5
10.60	5.0

If the laser is traversing from $x = 2.00$ to $x = 4.25$ to $x = 5.25$ in a quadratic path, what is the value of y at $x = 4.00$ using the direct method of interpolation and a second order polynomial?

- b) In order to find out the values of $3n$ number of unknowns, you need $3n$ number of equations. How can you get $3n$ number of simultaneous equations from $(n-1)$ data points in Quadratic Spline method of interpolation? 8
- c) What's the motivation behind using Spline method of interpolation instead of direct method of interpolation? Justify your answer with appropriate example. 5