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(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR
SECOND YEAR SECOND SEMESTER
MAIN EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: MAT 252

COURSE TITLE: ENGINEERING MATHEMATICS

DATE: 02/08/2018

TIME: 9 AM - 11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 2 Printed Pages. Please Turn Over.

QUESTION ONE (COMPULSORY)**(30MARKS)**

- (a) Given that
- x_n
- is an approximation to the root of the equation.

$$x^3 - 2x^2 - 4 = 0$$

- (i) Show using Newton-Raphson method that a better approximation
- $x_{n+1} + 4$
- is given by

$$x_{n+1} = \frac{2x_n^3 - 3x_n^2 + 4}{3x_n^2 - 6x_n} \quad (7 \text{ marks})$$

- (ii) Hence taking the first approximation
- $x_1 = 3.5$
- , find to four decimal places, the root of the equation (5 marks)

- (b) Show that
- $\nabla^2(2^x) = 2^x - 2.2^{x-h} + 2^{x-2h}$
- (5 marks)

- (c) Estimate the missing value in the table

x	1	2	3	4	5
f(x)	2	5	7	-	32

- (d) With a step size of
- $\Delta x = 0.2$
- compute three steps of Euler's method to approximate the solution of

$$\frac{dy}{dx} = -0.3y \text{ starting with } y=25 \text{ for } x=1$$

- giving your answer to four significant figures (6 marks)

- (e) For the shift operation E, show that

$$E^2 f(x) = f(x + 2h) \quad (3 \text{ marks})$$

QUESTION TWO**(20 MARKS)**

- (a) The table below represents a polynomial function f(x)

x	-1	0	1	2	3	4	5
f(x)	-6	-3	0	9	30	69	132

Use Newton-Gregory interpolation formula to determine to four significant figure the values of

(i) $F(-0.2)$

(ii) $F(3.4)$

(10 marks)

(b) (i) For the equation $x \log_{10} x = 1.2$ show that a root exists between $x=2$ and $x=3$.

(ii) Use regula-falsi method to find its root correct to three decimal places.

(10 marks)

QUESTION THREE (20 MARKS)

(a) Given the equation $x^2 - 5x + 3 = 0$ two iterative formulae can be formed to solve the equation

(i) Form these two iterative formulae (6 marks)

(ii) One of these iterative formulae will converge. Starting with $x_1 = 5$ test for convergence. (4 marks)

(iii) Hence use the one that will converge to find a solution for $x^2 - 5x + 3 = 0$ to three significant figure (4 marks)

(b) Find the polynomial of the lowest possible degree which assumes the values 3, 12, 15, -21 when x has the values 3, 2, 1, -1 respectively using Newton's divided difference formula (6 marks)

QUESTION FOUR (20 MARKS)

(a) Given that

$$f(0) = 1, \quad f(1) = 3, \quad f(3) = 55$$

(i) Find the lagrange interpolation polynomial which fits the data (9 marks)

(ii) Hence find an approximate value for $f(2)$ (2 marks)

(iii) Using inverse interpolation obtain a value of x when $y = 19$ given the following values

X	0	1	20
y	0	1	20

(9 marks)

QUESTION FIVE (20 MARKS)

(a) (i) Use Simpsons 1/3 rule to find the area under the circle.

$f(x) = 0.2 + 25x - 200x^2 + 675x^3 - 900x^4 + 400x^5$ in the range $[0, 0.8]$ using 4 strips to 6 decimal places (7 marks)

(ii) Determine the exact area (3 marks)

(iv) Hence determine the error to 6 decimal places (2 marks)

(b) Use the trapezoidal rule to evaluate

$\int_0^{\pi} \sin x \, dx$ using 6 intervals correct to four decimal places (8 marks)