MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECU 301: ENGINEERING MATHEMATICS X

DATE: 15/5/2019 **TIME: 11:00 – 1:00 PM**

INSTRUCTIONS TO CANDIDATES

Attempt question ***one (compulsory***) and any other ***two questions***.

QUESTION ONE (COMPULSORY)(30 MARKS)

a) Given that $f(-2)=12$, $f(-1)=16$, $f(0)=15$, $f(1)=18$, $f(2)=20$;

i.) Form the central difference table (3 marks)

ii.) Determine the value of $\delta^3_{y_{-\frac{3}{2}}}$ (3 marks)

b) Evaluate $f(10)$ given that $f(x)=168,\ 192,\ 336$ at $x=1,\ 7,\ 15$ respectively. Use Lagrange's interpolation. (4 marks)

c) Consider the table below

x	0	1	2	3	4
$f(x)$	1	0	1	10	33

Determine the cubic polynomial interpolating the functional values above,

(5 marks)

d) Obtain the approximate value of $I=\int_{-1}^{1} e^{-x^2}\cos x\,dx$ using 3 point Lobatto integration method

(5 marks)

e) Consider the equation $x^4 - x - 10 = 0$. Determine its root correct to three decimal places with $x_0 = 1.5,\ f(x_0) = -6.4375,\ f'(x_0) = 12.5$ using Newton Raphson method.

(5 marks)

QUESTION TWO (20 MARKS)

a) The population of a town in the decimal census was given as below.

year	1891	1901	1911	1921	1931
$f(x)$	46	66	81	93	101

Estimate the population for;

i) 1895 (8 marks)

ii) 1925 (8 marks)

b) Consider the differential equation $\frac{dy}{dx} = x + y\,;\ y(0) = 1$, using Euler's method determine the value of $y(0.3)$,compare the result with that obtained using analytical method.

(4 marks)

QUESTION THREE (20 MARKS)

a) Consider the data below;

x	0	1	2	3
$f(x)$	1	0	1	10

i) determine the Newton's forward difference interpolating polynomial for the data

(8 marks)

ii) work out $f(3.5)$ (5 marks)

b) The elevation above a datum line of seven points of a road under construction are given as in the table below.

x	0	300	600	900	1200	1500	1800
y	135	149	157	183	201	205	193

Calculate;

i) The gradient of the road at the middle point (4 marks)

ii) The acceleration of any particle at the middle of the road (3 marks)

QUESTION FOUR (20 MARKS)

a) Evaluate $\int_0^1 x\sqrt{1+x^2}\ dx$ using Romberg integration. (10 marks)

b) Use Radau three-point integration to determine the value of $\int_0^1 \frac{1}{2x^2+2x+1}\ dx$ (10 marks)

QUESTION FIVE (20 MARKS)

a) Consider the differential equation $y'' + xy' + y = 0,\ \ y(0) = 1\ ,\ y'(0) = 0$. Use Runge – Kutta method to calculate $y(0.1)$. (7 marks)

b) Using the method of undetermined coefficients work out the nodes and weights of the quadrature formula for;

$$\int e^{-x} f(x)dx = \lambda_0 f(x_0) + \lambda_1 f(x_1)$$ (13 marks)