MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

BACHELOR OF SCIENCE (BUILDING AND CIVIL ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

ECU 301: ENGINEERING MATHEMATICS X

DATE: 12/6/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer Question ONE 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 (4 marks)

ii.) Determine the value of $\delta^3_{y_{\frac{1}{2}}}$ (3 marks)

b) Show that $\delta=\nabla(1-\nabla)^{-\frac{1}{2}}$ (3 marks)

c) Consider the table below

x	6.0	6.1	6.2	6.3	6.4
$f(x)$	0.1750	-0.1998	-0.2223	-0.2422	-0.2596

Use the table to determine $f''(6.3)$, $error=O(h^2)$ (5 marks)

d) Calculate the value of the integral

$I=\int_0^{\frac{1}{2}}\frac{x}{\sin x}dx$ using Romberg integration (5 marks)

e) Use the Milne's predictor – corrector method to obtain the solution of the equation $y' = x - y^2$ at $x = 0.8$ given that $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$ (5 marks)

f) Determine the real root of the equation $xe^x - \cos x = 0$ using Newton Raphson method. (5 marks)

QUESTION TWO (20 MARKS)

a) i) State the Lagrange's formula of interpolation, using unequal intervals. (2 marks)

ii) From an experiment, we got the following values of a function $f(x)$

x	1	2	-4
$f(x)$	3	-5	5

Represent the function approximately by a polynomial of degree 2. Hence calculate $f(-5)$ (8 marks)

b) Evaluate the values of $y(1.1)$ *and* $y(1.2)$ for $y'' + y^2 y' = x^3$; $y(1) = 1$, $y'(1) = 1$ by using Taylor's series method. (10 marks)

QUESTION THREE (20 MARKS)

a) Calculate the Newton's forward difference interpolating polynomial for the data below.

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

Hence or otherwise obtain $f(3.5)$ (8 marks)

b) Determine the first and second derivatives of the function tabulated below at $x = 0.6$

x	0.4	0.5	0.6	0.7	0.8
y	1.5836	1.7974	2.0442	2.3275	2.6511

(12 marks)

QUESTION FOUR (20 MARKS)

a) Evaluate $\int_0^1 \frac{1}{1+x} dx$ using;

i.) Trapezoidal rule (5 marks)

ii.) Simpson's $\frac{1}{3}$ rule (5 marks)

iii.) Simpson's $\frac{3}{8}$ rule (4 marks)

b) The population of a town in the decimal census is given below. Estimate the population for the year 1925. (6 marks)

year	1891	1901	1911	1921	1931
Pop. Y thousands	46	66	81	93	101

QUESTION FIVE (20 MARKS)

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

$$\int e^{-x} f(x)dx = \lambda_0 f(x_0) + \lambda_1 f(x_1)$$ (8 marks)

b) Consider the differential equation $y'' + xy' + y = 0, \quad y(0) = 1 \,,\; y'(0) = 0$. Use Runge – Kutta method to calculate $y(0.1)$. (12 marks)