MACHAKOS UNIVERSITY

ISO 9001:2008 Certified

School of Engineering and Technology for the Bachelor's Degree

Third year examinations Second semester 2019

Engineering Mathematics X ECU 301

Department of Mathematics and Statistics.

Time 2hours

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

Question 1(30mks)

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

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

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

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

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, (5marks)

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

(5marks)

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. (5marks)

Question 2(20marks)

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 (8marks)

ii.) 1925 (8marks)

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. (4marks)

Question 3(20mks)

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 (8marks)

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

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 (4marks)

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

Question 4(20mks)

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

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

Question 5(20mks)

a.) Consider the differential equation $y'' + xy' + y = 0,\quad y(0) = 1\ ,\ y'(0) = 0$. Use Runge – Kutta method to calculate $y(0.1)$. (8mks)

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

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