TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

B.SC CIVIL ENGINEERING&ELECTRICAL ENGINEERING

SMA2471: NUMERICAL ANALYSIS 1

END OF SEMESTER EXAMINATION

SERIES:APRIL2016

TIME:2HOURS

DATE: MAY 2016

Instructions to Candidates

You should have the following for this examination

-*Answer Booklet, examination pass and student ID*

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE

a) If E, Δ and ∇ be shift, forward and backward difference operators, prove that

$$\Delta \equiv \Delta E^{-1}$$

(3 mks)

b) Determine the value of y when x = 0.1 using Euler's modified method given that $y(0) = 1$ if $\frac{dy}{dx} = y + x^2$ and h = 0.05.

(4 mks)

c) Determine the volume of revolution of a solid generated revolution, where the radius r(x), the perpendicular distance from the x-axis is given in the table below using Simpson's rule with n = 3 and h = 1.

x	0	1	2	3	4	5	6
r(x)	6.2	5.8	4.0	4.6	5.0	7.6	8.2

(4 mks)

d) By considering the base year 1970 as the initial time = 0 ,estimate the rental income in 1973,

Year	1970	1972	1974
Rental Income	100	180	210

(4 mks)

e) Given $y' = x^2 - y$, y(0) = 1, find y(0.1), y(0.2) using Runge-Kutta method of second order.

(5 mks)

f) Evaluate by Taylor's method the approximate value at x = 0.2 for the differential equation, $\frac{dy}{dx} = 2x - y^2$ $y(0) = 0$. Use h = 0.2 (5 mks)

g) Find the root of $f(x) = \cos x - xe^x$ using Newton's Raphson's iterative method if x_o=1 correct to 3dp up to the third step.

(5 mks)

QUESTION TWO

(a) Use a finite difference table to detect the error in the given data hence correct the value;

x	5	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0
f(x)	125.000	132.651	140.608	148.877	157.446	166.375	175.616	185.193	195.112	205.379	216.006

(6 mks)

(b) Using the Lagrange's interpolating formula, find the values of y when x = 10 from the following table;

x	5	6	9	11
y	12	13	14	16

(8 mks)

(c) Find the truncation error bound when estimating

$\int_{1.0}^{1.2} \sqrt{x}dx$ using Simpson's one third rule. (6 mks)

QUESTION THREE

a) Evaluate $\int_1^3 \frac{x^2}{1+x^2}\,dx$ where h = 0.5by Newton's cotes formula (8 mks)

b) Use the modified Euler's method to obtain y (0.6) correct to 4 d.p. given that $y' = y - x^2$ $y(0)=1$ take h = 0.2 (10 mks)

c) Differentiate between interpolation and extrapolation. (2 mks)

QUESTION FOUR

a) Use Runge – Kutta method to find $y(0.1)$, if $y' = \frac{y-x}{y+x}$, $y(0) = 1$ take h = 0.1, and correct to 4 d.p. (12 mks)

b) Use Milne's predictor-corrector method to obtain the solution of the equation,

$y' = \frac{1}{2}(1 + x^2)y^2$ at x = 0.4 given that $y(0) = 1$, $y(0.1) = 1.6$ $y(0.2) = 1.12$, $y(0.3) = 1.21$

(8 mks)

QUESTION FIVE

(a) The speed , v meters per second, of a car, t seconds after it starts, is shown in the following table

t	0	12	24	36	48	60	72	84	96	108	120
v	0	3.60	10.08	18.90	21.60	18.54	10.26	5.40	4.50	5.40	9.00

Using Simpson's $\frac{1}{3}$ rule, find the distance travelled by the car in 2 minutes.

(3 mks)

(b) Evaluate $\int_0^1 \frac{1}{1+x^2}\,dx$, using Romberg's method, correct to 4 decimal places. Hence find an approximate value of π.

(6 mks)

(c) Using Taylor's series of y(x), find y(0.1) correct to 4 decimal places if y(x) satisfies $y' = x - y^2$ and y(0) = 1.

(5 mks)

(d) Using Adam's Bashforth method, find y(1.4) given $y' = x^2(1+y)$, y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, and y(1.3) = 1.979.

(6 mks)

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