TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN MECHANICAL ENGINEERING (DMEN 4)

AMA 2251: ENGINEERING MATHEMATICS IV

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consist of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

Question One (Compulsory)

$$F(t) = e^{2t}t^2 + e^{-t}\cos t$$

a) (i) Determine the Laplace transform of **(4 marks)**

$$F(s) = \frac{s+2}{s^2-4}$$

(ii) Determine the inverse Laplace transform of **(8 marks)**

$$F(t) = e^{4t}$$

(iii) Obtain from first principles the Laplace transform of **(4 marks)**

b) (i) Use Maclaurin's series to obtain the first three terms of the power series for $f(x) = \cos 2x$

(5 marks)

$$f(x) = x^4 + 2$$

(ii) Use Taylor's series to express the function as a power series of x + 1

(8 marks)

c) Determine the Newton-Gregory forward difference interpolating polynomial for the data below. Hence evaluate f(2.5) **(6 marks)**

x	0	1	2	3	4
f(x)	1	7	23	55	109

Question Two

$$F(t) = \sin^2 t$$

a) Determine the Laplace transform **(3 marks)**

$$F(s) = \frac{s+2}{s^2+2s+2}$$

b) Determine the inverse Laplace transform of **(5 marks)**

c) Use Laplace transforms to solve the differential equation.

$$2\frac{dy}{dt} - y = \sin t$$

given at t = 0, y = 1 **(12 marks)**

Question Three

$$f(x) = \left(e^x + 1\right)\ln(1+x)$$

a) Use Maclaurin's series to obtain the first three terms of the power series for **(10 marks)**

$$\tan(x+h)$$

b) Use Taylor's series to obtain the power series for up to the term in h^2. Hence obtain the power series for $\tan\left(\pi/4 + h\right)$ and use it to determine $\tan 46^o$ correct to four decimal places.

(10 marks)

Question Four

$x_0 = -1.3$

a) Apply the Newton-Raphson method taking to determine correct to 4 significant figures the $x^3 - 6x^2 + 12 = 0$ root of the equation **(6 marks)**

b) The data in the table below defines a function:

x	1	2	3	4	5	6
f(x)	4	14	40	88	164	274

$f(2.5)$

(i) Use the Newton-Gregory forward difference formula to evaluate

(ii) Use the Newton-Gregory backward difference formula to evaluate f (5.8)

(14 marks)

Question Five

a) Solve using the Laplace transforms of the differential equation:

$\frac{dx}{dt} + 2x = 10e^{3t}$

give at t = 0, x = 6 **(10 marks)**

$f(x) = \cos(x + h)$

b) Use Taylor's series to obtain the power series for up to the term in h^4. Hence obtain $\cos\left(\pi/3 + h\right)$ the power series for and use it to determine the value of cos 62° correct to 4 decimal places. **(10 marks)**