EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

END TERM EXAMS

DIPLOMA IN AURONAUTICAL ENGINEERING

Engineering Mathematics

STREAM: MODIII(Avionics /Airframes & Engines)   **Duration: 3HRS**

DAY/DATE: 06/04/2017   **TIME: 9.00 – 12.00PM**

INSTRUCTION TO CANDIDATES

1. *This paper consists of **FOUR (4)** pages*
2. *You should have the following for this examination:*
   Answer booklet;
   Mathematical tables / Electronic calculator.
   Smith chart

3. *Answer **ANY FIVE (5) QUESTIONS** in this paper*

1.(a)If x_n is an approximation root for the equation $4x - 5e^{-x} + 4 = 0$, show using
Newton Raphson formula that

A better approximation $x_{n+1} = \dfrac{5e^{-x_n}(x_{n+1}) - 4}{4+5e^{-x_n}}$

Taking $x_0 = 1$ obtain the root of the equation **(10marks)**

(b) The table below gives some values recorded from an experiment

x	0.0	0.1	0.2	0.3	0.4	0.5	0.6
f(x)	1.000	0.991	0.952	0.973	1.384	2.875	6.616

Use Gregory Newton formula of interpolation to evaluate correct to four decimal places

(i) f (- 0.26)
(ii) f (0.52) **(10marks)**

2. Sketch the graph of the function

$$f(t) = \begin{cases} \dfrac{t^2}{\pi} & 0 \le t \le \pi \\ 2\pi - t & \pi \le t \le 2\pi \\ f(t + 2\pi) & \end{cases}$$

in the interval $-2\pi < t < 2\pi$ and hence

i.   Calculate its 3rd percentage harmonic
ii. Find its Fourier series representation

(20 marks)

3. (a) Taking -1.2 as the first approximation to the negative root of the equation $14x^3 - 11x^2 + 22 = 0$, use Newton-Raphson method to evaluate the root correct to four decimal places

(8 marks)

(b) Table below shows data obtained in an experiment. Use Gregory- Newton interpolation formulae to evaluate **(12 marks)**

I. f(-0.35)
II. f(x)

t	-0.5	-0.3	-0.1	0.1	0.3	0.5	0.7
f(t)	2.125	0.813	-0.189	-0.131	-0.147	0.525	2.653

4. Sketch the graph of the function

$F_{(t)} = t^2 - 4t + 3 \quad 0<t<4$

$F_{(t+4)}$

In the interval -4 < t < 8 and hence.

Find its Fourier series representation

Use the above results to show that

$$\frac{\pi^2}{6} \sum_{n=1}^{\infty} \frac{1}{n^2}$$

Determine the value of a. **(20marks)**

5. Determine the eigen values and eigen vectors for the equation $Ax = \lambda x$ where

$A = \begin{bmatrix} 2 & 0 & 1 \\ -1 & 4 & -1 \\ -1 & 2 & 0 \end{bmatrix}$ **(20marks)**

6. a) Given the matrix $M = \begin{bmatrix} 2 & -1 \\ 2 & 5 \end{bmatrix}$ find the eigen values and the corresponding

   eigen vectors of the matrix of M. **(12marks)**

   b) Find the eigen values of the matrix $\begin{bmatrix} 1 & 4 & -1 \\ -1 & 6 & -1 \\ 2 & -2 & 4 \end{bmatrix}$ **(8marks)**

7.a) Given that $z = x^2 + ay^2 - 2xy + j(bx^2 - y^2 + 2xy)$ is analytic determine the

   values of a and b **(6marks)**

   b) Given the function $u(x, y) = x^2 - y^2 + x$ show that

   i.   u is harmonic

   ii. Determine a harmonic conjugate function v(x,y) such that $f(z) = u + jv$

   (14marks)

8. a) Show that the function $W = z^2$ is regular **(4marks)**

   b) find the image in the W-plane of the circle $|z| = 2$ under the transformation

   $\dfrac{2z+j}{z-3j}$ **(16marks)**