EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

END TERM II EXAMS

ENGINEERING MATHEMATICS II

DIPLOMA IN AERONAUTICAL ENGINEERING AVIONICS

STREAM: Module II (Avionics + Airframes & Engines) **Duration: 3 Hrs**

DAY/DATE: 03/04/2017 **TIME: 9.00 – 12.00PM**

INSTRUCTION TO CANDIDATES

You should have the following for this examination:

i) Answer booklet
ii) Mathematical table/ scientific calculator

Answer ***ANY THREE QUESTIONS IN SECTION A*** *and* ***ANY TWO IN SECTION B*** *in this paper*
All questions carry equal marks.
Maximum marks for each part of a question are as shown

This paper consists of Four (4) printed pages.
Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Answer any ***FIVE*** *questions*

1. (a) Find the general solution of the differential equation

$$(4y+3x)\frac{dy}{dx}=3x-y$$ **(9 marks)**

(b) The displacement x metres of a body fixed from a point 0 at any time t seconds satisfies the differential equation

$$\frac{d^2x}{dt^2}-2\frac{dx}{dt}+10x=\sin 3t\ .$$

Use the method of undetermined coefficients to find an expression for the

displacement x(t)

(11 marks)

2. (a) show that the solution to the differential equation

$(3y^2+4xy)dx+(2xy+x^2)dy=0$ takes the form $x^3y(x+y)=k$, where k is a constant

(9 marks)

(b) Use the method of undetermined coefficients to obtain the general solution of the differential equation:

$$\frac{d^2y}{dx^2}-2\frac{dy}{dx}+2y=6x^2+4$$ **(11 marks)**

3. a) Given that

$$M=\begin{bmatrix}4 & 4 & -2\\ -2 & 4 & 4\\ 4 & -2 & 4\end{bmatrix}$$

Verify that $MM^T=\lambda I$, where I is an identity matrix and λ is a constant. Hence solve the equation

$$4x_1+4x_2-2x_3=18$$
$$-2x_1+4x_2+4x_3=6$$
$$4x_1-2x_2+4x_3=12$$ **(10 marks)**

(b) If $\underset{\sim}{A}=x^2y\underset{\sim}{i}+(xy+yz)\underset{\sim}{j}+xz^2\underset{\sim}{k}$

$\underset{\sim}{B}=yz\underset{\sim}{i}-4xz\underset{\sim}{j}+3xy\underset{\sim}{k}$

$Q=3x^2y+xyz-5y^2z^2-4$

Determine at the point (1, 3, 1)

$\nabla.\ A$

$\nabla*\ B$

Curl .curl A **(10 marks)**

4. (a) Find the Laplace transform of f(t) = sin at cosh at **(3 marks)**

(b) Find the inverse Laplace transform of $\frac{1}{s^3-3s^2+2s-6}$ **(8 marks)**

(c) Use Laplace transforms to solve the differential equation

$\frac{d^2y}{dt^2}+2\frac{dy}{dt}+2y=4$ given that at t = 0, y = 0 and $\frac{dy}{dt}=$ - **(9 marks)**

5. a) if $\phi = x^2y + xz^2$ determine gradϕ at the point P(1,3,2) **(4 marks)**

b) if **A**=$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 6 & 7 \\ 5 & 8 & 9 \end{bmatrix}$ and **B**=$\begin{bmatrix} -2 & 6 & -4 \\ -1 & -6 & 5 \\ 2 & 2 & -2 \end{bmatrix}$

Verify that AB=kI where I is a unit matrix and k is a constant. Hence solve the equations.

$$x_1 + 2x_2 + 3x_3 = 2$$
$$4x_1 + 6x_2 + 7x_3 = 2$$
$$5x_1 + 8x_2 + 9x_3 = 3$$

(10 marks)

c) Three coplanar vectors are

$X = 2i - j + 3k$

$Y = ai + 2j + k$

$Z = i - 3j + 4k$

Determine the value of a. **(6 marks)**

6. a) Given that $z = \sin\left({}^{y}/_{x}\right)$, show that $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial x} = 0$ **(4 marks)**

b) the deflection y at the center of uniformly loaded plate , suspended at the edge is given by:

$y = \frac{KWd^4}{t^3}$, where W is the load, d is the diameter of the plate, t is the thickness of the plate and K is a constant. Determine the approximate percentage change in y if W is increased by 3%, d is decreased by 2% and t is increased by 4% using partial differentiation. **(7 marks)**

c) Determine and classify the turning points of the function $Z = x^2 - 2x - 4y^2 + 6$ **(9marks)**

7. a) (i) Determine the Taylor's series for $\ln(a+h)$ up to and including the term in h^5

(ii) Hence determine the value of $\ln 12$ correct to five decimal places, given that $\ln 10 = 2.30258$ **(8 marks)**

b) (i) Determine the Maclaulin's series for $f_{(x)} = cos^2 2x$ up to the term in x^6. Hence

(ii) evaluate $\int_1^2 x^2 cos^2\, 2x$ correct to four decimal places **(12 marks)**

8. a) Find the general solution of the differential equation

$(2xy + 3cosy)dx + (x^2 - 3xsiny)dy = 0$ **(6 marks)**

b) Solve the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 2x + e^{2x}$, given that $y_{(0)} = 1$ and $y^1{}_{(0)} = 0$, by using the method of undetermined coefficients **(14 marks)**

******End******