# EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

## END TERM II EXAMS

## ENGINEERING MATHEMATICS I
## DIPLOMA IN AERONAUTICAL ENGINEERING AVIONICS

**STREAM: Module I (TELS)** **Duration: 3 Hrs**

**DAY/DATE: 04/04/2017** **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.**

**SECTION A: ENGINEERING MATHEMATICS I**

Answer any **FIVE** questions.

1. (a) (i) Evaluate

$$\frac{4+j6}{6-j4}$$

(ii) Express $z = 4 + j5$ in polar form

(iii) Represent the complex number $3 + j2$ in an argand diagram (**10 marks**)

(b) Express $\sin^7\theta$ in terms of $\sin n\theta$ (**10 marks**)

2. (a) Work out for x $\log_{16} x + \log_8 x + \log_4 x + \log_2 \mathrm{x} = \frac{25}{3}$ **(5marks)**

(b) Solve the following quadratic equations;

i. $x^2 - 2x + 1 = 0$ (Factorization)

ii. $x^2 - 4x - 3 = 0$ (completing the square method)

iii. $x^3 - 5x^2 - 2x + 24 = 0$ **(15 marks)**

3. (a) Prove the following trigonometric identities

i. $\frac{2\tan\theta}{1+tan^2\theta} = 2\sin\theta\cos\theta$

ii. $\left(\frac{\csc\theta+\cot\theta}{\tan\theta+\sec\theta}\right)\tan\theta = \frac{\cos\theta+1}{\sin\theta+1}$ **(7 marks)**

(b) Solve the following trigonometric equation

$3sin^2 3\theta + 2\sin 3\theta - 1 = 0$ for $0 \leq \theta \leq 360^0$

**(9 marks)**

(c) Simplify the following

i. $\sin 25^0 \cos 92^0 + \cos 25^0 \sin 92^0$;

ii. $\cos 64^0 \cos 12^0 + \sin 64^0 \sin 12^0$;

iii. $2\sin 72^0 \cos 72^0$

iv. $1 - sin^2 40^0$ **(4 marks)**

4. (a) Solve the following equations

i. $5.2^{2x-1} = 3^{x+2}$

ii. $\frac{\log_5 125}{\log_{16} 243}$ **(5marks)**

(b) Prove that for a quadratic equation $ax^2 + bx + c = 0$ solution of x is

given by $x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$ **(5 marks)**

(c) Find the polar co-ordinates equivalent to Cartesian co-ordinates of (-12, -5) **(4 marks)**

(d) Calculate the five roots of $(4\angle 21°)^{-\frac{2}{5}}$ in the a+jb form, correct to four decimal places. **(6 marks)**

5. (a) Differentiate $y = \frac{4\cos x}{6x^4}$ **(5 marks)**

(b) (i) given that $Pe^x + Qe^{-x} = 3\cosh x - 4\sinh x$, determine the values of P and Q

(ii) Prove that

$$2cosh^2\theta - 1 = \cosh 2\theta$$

**(8 marks)**

(c) Evaluate

$\int_0^1 \frac{-(4x^2+9x+8}{(x+1)^2(x+2)}dx$ correct to four decimal places using partial fractions

**(7 marks)**

6. (a) Write the identities connecting hyperbolic functions corresponding to:

(i) $\sec^2\theta = 1 + \tan^2\theta$

(ii) $\cos ec^2\theta = 1 + \cot^2\theta$ **(1 mark)**

(b) Express $\cos 3\theta$ in terms of powers of $\cos\theta$ . **(4 marks)**

(c) Find the polar co-ordinates equivalent to Cartesian co-ordinates of (12,-7) **(4 marks)**

(d) The resonant frequency of a vibrating shaft is given by $f = \frac{1}{2\pi}\sqrt{(\frac{k}{I})}$, where k is the stiffness and I is the inertia of the shaft. Using binomial expansion, determine the approximate percentage error in determining the frequency using the measured values of k and I, when the measured value of k is 3% too large and the measured value of I is 1.5% too small. (**5 marks**)

(e) Determine the values of $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for the cycloid $x=3(\theta-\sin\theta), y=3(1-\cos\theta)$ at the point $\theta=\frac{\pi}{3}$ (**6 marks**)

7. (a) In how many ways can five beads, chosen from eight different beads be threaded on to a ring. (**4 marks**)

(b) Show that $\frac{d\left(\arctan x\right)}{dx}=\frac{1}{1+x^2}$ (**4 marks**)

(c) Differentiate from first principles $f(x)=\frac{1}{5x+3}$ (**6 marks**)

(d) The pressure p and volume V of a gas are related by the equation $pV^{1.4}=C$. Find the approximate percentage change in C when the pressure is increased by 2.3 percent and the volume is decreased by 0.84 percent. (**6 marks**)

8. (a) Prove the identity $\cosh^2 x-\sinh^2 x=1$ (**2 marks**)

(b) Solve the equation $\tan\theta=2\sin\theta$ ,for values of $\theta$ from $0° to 360°$ inclusive. (**4 marks**)

(c) Derive the term containing $y^{12}$ in the expansion of $(y^2-\frac{x}{4})^{10}$ (**4 marks**)

(d) Find the stationary points of the surface $z=2x^3-3xy+\frac{3}{4}y^2$ and determine their nature. (**10 marks**)

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