EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

DIPLOMA IN AURONAUTICAL ENGINEERING AVIONICS

ELECTROMAGNETIC FIELD THEORY

STREAM: Y3 (Avionics)   **Duration: 3 Hrs**

DATE: 07/04/2017/   **TIME: 9:00 – 12:00 PM**

INSTRUCTION TO CANDIDATES

1. *This paper consists of*
2. *You should have the following for this examination:*
   Answer booklet;
         Mathematical tables/ Electronic calculator.
3. *Answer **ANY FIVE** in this paper*

Take

Absolute permeability $\mu = 4\pi \times 10^{-7} H/m$

Relative permeability $\mu = 1 \ H/m$

Absolute permittivity $\varepsilon_0 = 8.854 \times 10^{-12} F/m$

Relative permittivity $\varepsilon_0 = 1 \ F/m$

1. (a) Define electromagnetic radiation. **(2 marks)**
   (b) (i) Name six electromagnetic energy. **(6 marks)**
   (ii) State the sources detectors and uses (applications) of any four (4) of the above named electromagnetic waves. **(12 marks)**

2. (a) Define the following terms used in electrostatics their measurement units.
   (i) Electrical field
   (ii) Electrical potential
   (iii) Static dielectric constants. **(9 marks)**

   (b) Find the source on charge Q_1, 20μC due to charge Q_2, -300μC where Q_1 is at (0, 1, 2) and Q_2 is at (2, 0, 0). **(11 marks)**

3. (a) (i) state coulomb's law. **(2 marks)**
   (ii) Define work in reference to electromagnetics. **(2 marks)**

   (b) Calculate the electrostatic force of repulsion between two α- particles when at a distance of 10^{-13}m from each other. Charge of α-particle is 3.2 x 10^{-12}C. **(7 marks)**

   (c) Find E at (0, 3, 4) m in Cartesian coordinates due to point charge Q = 0.5μC at the origin. **(9 marks)**

4. (a) state Gauss' law. **(2 marks)**
   (b) Find the work done in moving a point charge Q = -20μC

   (i) From the origin to (4, 0, 0),

   (ii) From (4, 0, 0) to (4, 2, 0). **(10 marks)**

   (c) Find E at (0, 0, 5) m due to Q_1 = 0.35μC at (4, 0, 0) m and Q_2 = -0.55μC at (300). Give a sketch figure. **(8 marks)**

5. (a) state the units for the following magneto static parameters.
   (i) Magnetic field strength,

   (ii) Magnetic potential,

   (ii) Magnetic force,

   (iv) Susceptibility,
   (v) Flux density. **(5 marks)**

   (b) (i) State Biot - Savart law. **(2 marks)**

(ii)   Calculate the magnetizing force and flux density at a distance of 5 cm from a long straight circular conductor carrying a current of 250 A and placed in air. (diameter = 2mm)   **(6 marks)**

(iii)   A wire 2.5 m long is bent (i) into a square (ii) into a circular. If the current flowing through the wire is 100 A, find the magnetizing force at the square and the center of the circle.   **(7 marks)**

6. (a) (i)   State Ampere's law

        (ii)   Define each of the following with respect to electrostatics.

            (I)   Field intensity
            (II)   Electric flux.   **(8 marks)**

(b)   An isolated dielectric sphere of radius R in free space has a relative permittivity of Ɛr. There is a point charge Q at the center of the sphere. Obtain expression for electric field inside the sphere.   **(4 marks)**

(c)   A thin cylindrical conductor of radius a, infinity in length carries a current I. Find H at all points using Ampere's law.   **(8 marks)**