2506/102
2507/102
AIRCRAFT ELECTRICAL TECHNOLOGY
June/July 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAMES AND ENGINES OPTION)
(AVIONICS OPTION)

MODULE I

AIRCRAFT ELECTRICAL TECHNOLOGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
 Answer booklet;
 Mathematical tables / Non-programmable scientific calculator;
 Drawing instruments.
This paper consists of EIGHT questions in TWO sections; A and B.
Answer THREE questions from section A and TWO questions from section B in
the answer booklet provided.
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.
 Take: *Permittivity of free space,* $\varepsilon_0 = 8.854 \times 10^{-12}\ F/m$
    Permeability of free space, $\mu_0 = 4\pi \times 10^{-7}\ H/m$

This paper consists of 8 printed pages.

Candidates should check the question paper to ascertain that
all the pages are printed as indicated and that no questions are missing.

   Turn over

SECTION A: AIRCRAFT ELECTRICAL INSTALLATION TECHNOLOGY

*Answer **THREE** questions from this section.*

1. (a)   State **three** safety gears required in aircraft maintenance work place.   (3 marks)

    (b)   Describe each of the following aircraft safety hazards:

          (i)   turbulence;

          (ii)   bird strike.

                                                                                    (4 marks)

    (c)   With aid of a labelled diagram, describe the split-parallel aircraft electrical power
          distribution system.   (7 marks)

    (d)   (i)   State **two** types of batteries used in aircrafts.

          (ii)   An aircraft battery is used to start it's engine. The starter draws a current of
                 1000 A for 30 seconds and the battery voltage remains at 12V during this
                 period. Determine the:

                 (I)   power delivered to the starter;

                 (II) electrical energy used to start the engine.

                                                                                    (6 marks)

2. (a)   List **three** qualities of aircraft electrical wiring cables.   (3 marks)

    (b)   Draw the wiring diagram of a one-way switch controlling one lamp.   (4 marks)

    (c)   With aid of a diagram, outline the procedure of making a britannia cable joint.
                                                                                    (7 marks)

    (d)   Draw the aircraft electrical symbols for each of the following:

          (i)   antenna;

          (ii)   shielding;

          (iii) radiations.

                                                                                    (6 marks)

3. (a) State **three** merits of Bayonet Neil-Concelman (BNC) connectors. (3 marks)

    (b) Describe each of the following wiring systems:

        (i) conduit;

        (ii) trunking.
        (6 marks)

    (c) With aid of a labelled diagram, describe the operation of a thermal-type circuit breaker. (7 marks)

    (d) Outline the steps involved in crimping a cable. (4 marks)

4. (a) State **two** advantages of ring over radial power circuits. (2 marks)

    (b) Describe each of the following ground proximity warning system with reference to aircraft:

        (i) mode 1;

        (ii) mode 2.
        (6 marks)

    (c) (i) State **two** benefits of structured cabling.

        (ii) Outline the subsystems of structured cabling.
        (8 marks)

    (d) Figure 1 shows a smoke detector circuit used in aircraft. Explain its operation.
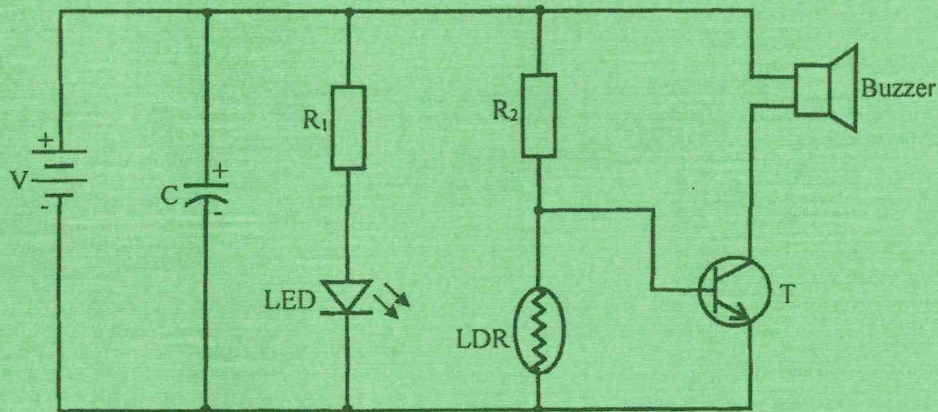   (4 marks)

Fig. 1

5. (a) Describe each of the following aircraft lights:

   (i) navigation;

   (ii) strobe.

   (6 marks)

   (b) (i) Define brightness with respect to illumination stating its units. (2 marks)

   (ii) A 100 W lamp emits 1,400 lumens. The lamp is placed in a globe of 40cm diameter to give uniform brightness of 250 milli-lumens/m² in all directions.

   Determine the:

   (i) flux emitted by the globe;

   (ii) flux absorbed by the globe;

   (iii) percentage of light absorbed by the globe.

   (6 marks)

   (c) A floor measuring 30m x 10m is to be illuminated to 250 lux using a set of 300W lamps. The coefficient of utilization and the maintenance factor are 0.4 and 0.9 respectively. The luminous efficiency of each lamp is 14 lumen per Watt. Determine the:

   (i) total lumens;

   (ii) luminous flux emitted per lamp;

   (iii) number of lamps required.

   (6 marks)

SECTION B: ELECTRICAL ENGINEERING PRINCIPLES

*Answer **TWO** questions from this section.*

6.   (a)   State **three** basic SI units.   (3 marks)

       (b)   Figure 2 shows an electric circuit. Each cell has an emf of 9 V and internal resistance of $0.1\ \Omega$.
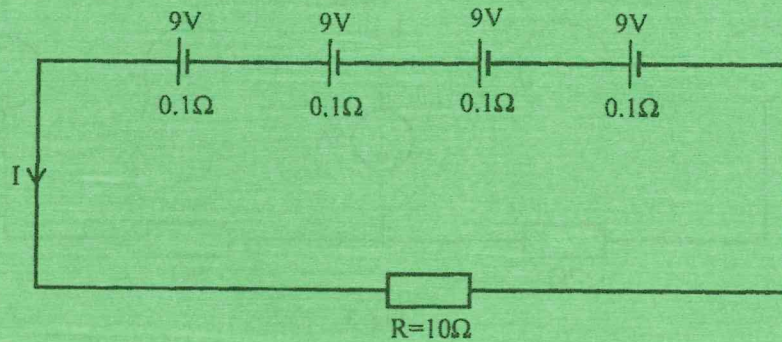

Fig. 2

Determine the:

          (i)   equivalent emf of the combination;

          (ii)   equivalent internal resistance;

          (iii)   current, I;

          (iv)   potential difference across resistor R.

                                                                  (8 marks)

       (c)   An indicating instrument has a resistance of 40 Ω and a maximum deflection when a current of 15 mA flows. Determine the value of resistance required to convert the instrument to:

          (i)   an ammeter with a maximum deflection of 50 A;

          (ii)   a voltmeter with a range 0 - 250 V.

                                                                 (6 marks)

       (d)   State **three** demerits of attraction-type moving iron instruments.   (3 marks)

7. (a) State superposition theorem. (2 marks)

(b) Figure 3 shows a resistive network. Using superposition theorem, determine the branch current I_1. (9 marks)
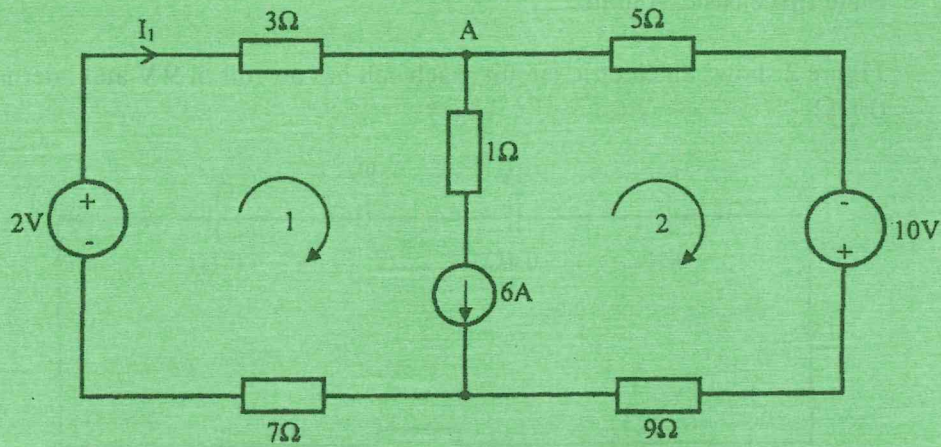

Fig. 3

(c) State Lenz's law of electromagnetic induction. (2 marks)

(d) Figure 4 shows a closed cast steel magnetic circuit. A coil of 200 turns is wound around the 6 cm length of the circuit and a current of 0.4 A flows.
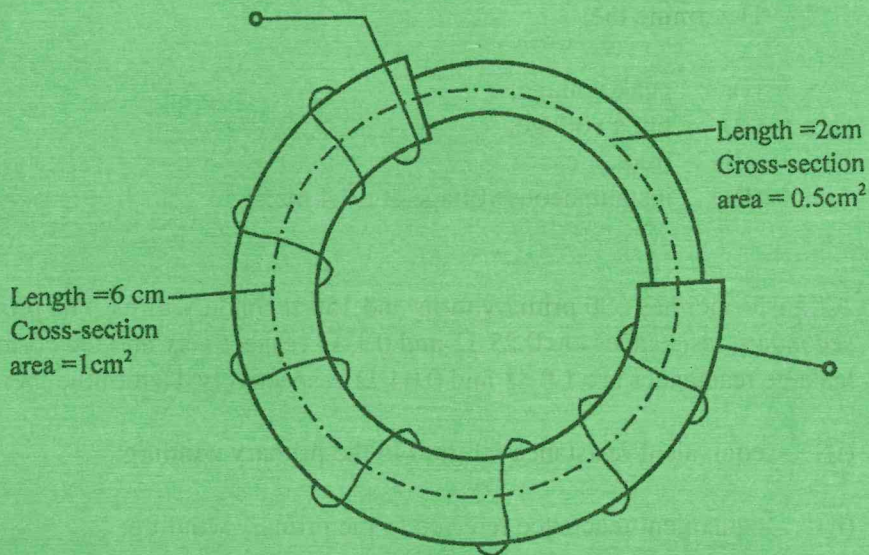

Length =2cm
Cross-section
area = 0.5cm²

Length =6 cm
Cross-section
area =1cm²

Fig. 4

Determine the:

(i)   reluctance of 6 cm long path;

(ii) reluctance of 2 cm long path;

(iii) total circuit reluctance;

(iv) total flux in the circuit.

(7 marks)

8. (a) (i)   Define 'dielectric' with reference to capacitors.

(ii) A parallel plate capacitor has a capacitance of 0.2 μF. It is supplied with a voltage of 1.25 kV across its terminals. The dielectric has a relative permittivity of 6 and a dielectric strength of 50 mV/m. Determine the:

(I)   thickness of the dielectric;

(II) area of the plates.

(5 marks)

(b) (i) Define 'instantaneous value' with respect to alternating current.

(ii) An alternating voltage is given by the expression $V = 282.8sin314\,t$ volts.

Determine the:

(I) peak voltage;
(II) r.m.s voltage;
(III) frequency;
(IV) instantaneous voltage at t = 4 ms.

(7 marks)

(c) A transformer has 600 primary turns and 150 secondary turns. The primary and secondary resistances are 0.25 Ω and 0.1 Ω respectively and the corresponding leakage reactances are 1.0 Ω and 0.04 Ω respectively. Determine the:

(i) equivalent resistance referred to the primary winding;

(ii) equivalent reactance referred to the primary winding;

(iii) equivalent impedance referred to the primary winding;

(iv) phase angle of the impedance.

(8 marks)

THIS IS THE LAST PRINTED PAGE.