2506/102
2507/102
AIRCRAFT ELECTRICAL TECHNOLOGY
March/April 2024
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 any **THREE** questions from section **A** and any **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,*** $\varepsilon_o = 8.854 \times 10^{-12}\ F/m$
Permeability of free space, $\mu_0 = 4\pi \times 10^{-7}\ H/M$

This paper consists of 7 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: AIRCRAFT ELECTRICAL INSTALLATION TECHNOLOGY

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

1. (a) State **three** aircraft safety hazards. (3 marks)

(b) Table 1 shows aircraft electrical installation tools and their functions. Complete the table. (5 marks)

Table 1

Tool	**Function**
——	Cutting and stripping insulation
Nose pliers	——
——	Pulling wires through conduits
——	Loosening or fastening screws
Crimper	——

(c) With aid of a labelled block diagram, describe the operation of a variable speed constant frequency (VSCF) generator system for aircrafts. (8 marks)

(d) (i) Define 'wild frequency' with respect to aircrafts.

(ii) Identify the aircraft electrical components represented by each of the following symbols. (4 marks)

I 

II 

III 

2. (a) (i) State **three** factors considered when selecting connectors for coaxial cables

(ii) Describe BNC coaxial cable connectors.

(6 marks)

(b) With aid of a diagram, describe the process of making a telegraph joint.

(7 marks)

(c) With aid of a labelled diagram, describe pillar terminal used in aircraft cable termination. (7 marks)

3. (a) State **three** merits of using copper wires in aircrafts electrical wiring system.

(3 marks)

(b) (i) Define each of the following with respect to fuses:

(I) fusing current;
(ii) fuse rating.

(ii) A fuse has a fusing current of 10 A and a fusing factor of 1.5. Determine the current rating of the fuse.

(4 marks)

(c) With aid of a labelled diagram, describe the working principle of a magnetic circuit breaker. (7 marks)

(d) State **three**:

(i) merits of vacuum circuit breakers;
(ii) benefits of bonding in electrical wiring systems.

(6 marks)

4. (a) Describe each of the following structured cabling subsystems in aircrafts:

(i) entrance facility;
(ii) equipment room;
(iii) backbone cabling;
(iv) work area.

(8 marks)

(b) With aid of a diagram, describe the construction of a shielded twisted pair (STP) cable used in aircraft structured cabling. (6 marks)

(c) A fibre optic cable has a relative refractive index of 0.012 and a numerical aperture of 0.22. Determine the:

(i) core refractive index;
(ii) cladding refractive index;
(iii) critical angle.

(6 marks)

5. (a) (i) Distinguish between illumination and brightness with respect to lighting systems.

(ii) State Lamberts cosine law of illumination.

(4 marks)

(b) An aircraft boarding area 120 m by 60 m is to be illuminated by identical 1000 W lamps mounted on 12 towers uniformly distributed over the area. An illumination of 1000 lumen/m^3 is required on the ground and the efficiency of the lamp is 30 lumens/W. Assuming 40% of the total light reaches the ground, determine the:

(i) total luminous flux required to be produced;
(ii) luminous flux contributed by each tower;
(iii) output of each lamp;
(iv) number of lamps on each tower.

(8 marks)

(c) Figure 1 shows an aircraft lighting scheme with four lamps each of 2000 cd. At point C, determine the:

(i) illumination due to lamp L1;
(ii) illumination due to lamp, L2;
(iii) illumination due to lamps L1 and L2;
(iv) total illumination.

(8 marks)

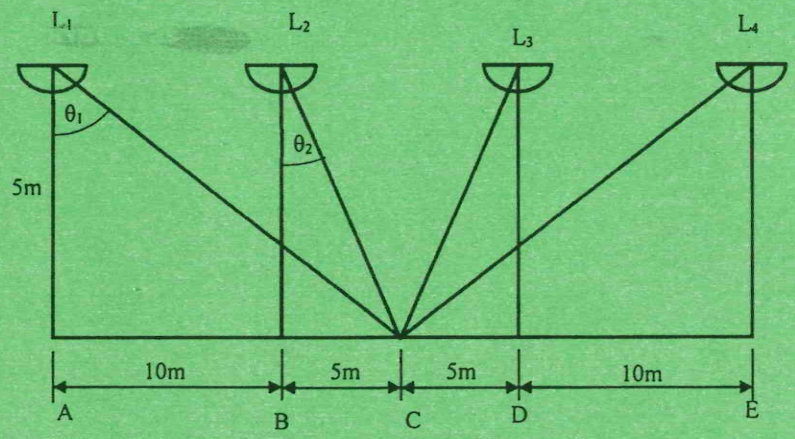

Fig. 1

SECTION B: ELECTRICAL ENGINEERING PRINCIPLES

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

6. (a) (i) Distinguish between primary and secondary cells.

(ii) State **two** battery charging methods.

(4 marks)

(b) Eight cells each with an internal resistance of 0.2 Ω and emf of 2.2 V are used to supply a 100 Ω load. Determine the current flowing in the circuit if the cells are connected in:

(i) series;
(ii) parallel.

(8 marks)

(c) Figure 2 shows a bridge network. Using Kirchhoff's laws, determine the current flowing through the:

(i) 11Ω resistor;
(ii) 3Ω resistor.

(8 marks)

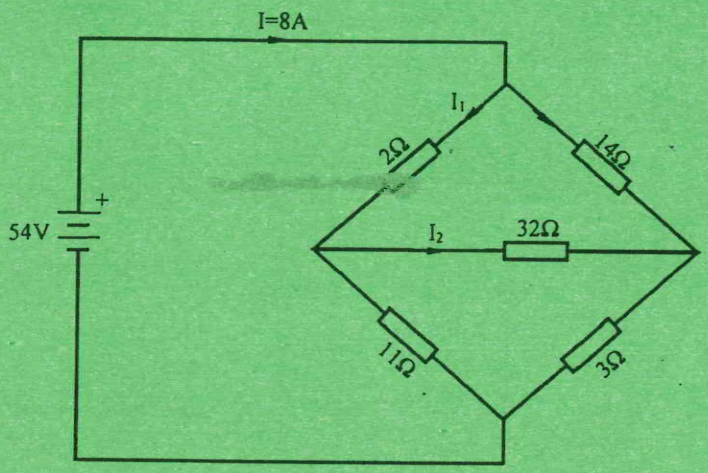

Fig. 2

7. (a) (i) Define 'reluctance' with regard to electromagnetism.

(ii) State Lenz's law of electromagnetic induction.

(3 marks)

(b) Figure 3 shows a magnetic circuit with a steel core having a cross-section area of 2 cm^2 and an air gap 1 mm wide. The magnetic field strength in the circuit is 750 A/m and the flux density at the airgap is 0.8T. Determine the:

(i) reluctance of the steel core;
(ii) reluctance of the air gap;
(iii) total reluctance in the circuit;
(iv) flux density in the circuit.

(9 marks)

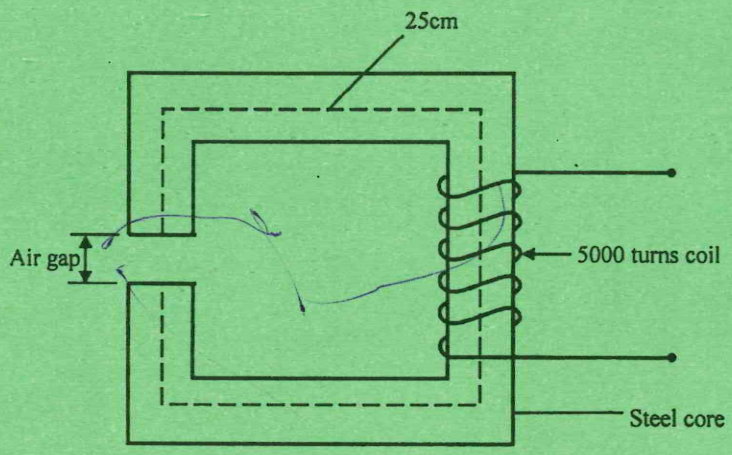

Fig. 3

(c) A 400 pF parallel plate capacitor is charged to a potential difference of 100 V. The plates have a cross-sectional area of 200 cm^3 and the dielectric has a relative permittivity of 2.3. Determine the:

(i) charge stored in the capacitor;
(ii) distance between the plate;
(iii) flux density;
(iv) energy stored in the capacitor.

(8 marks)

8. (a) Figure 4 shows an a.c waveform. Identify the quantities labelled **X**, **Y** and **Z**.

(3 marks)

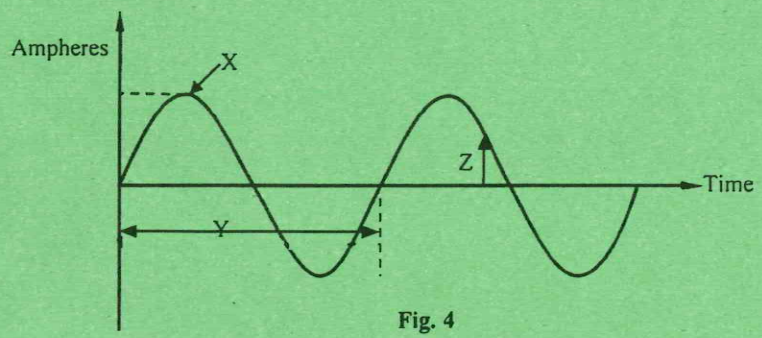

Fig. 4

(b) Figure 5 shows a circuit. Determine the:

(i) inductive reactance, X_L;
(ii) capacitive reactance, X_C;
(iii) total circuit impedance, Z;
(iv) current flowing through the circuit, I;
(v) phase angle Φ.

(9 marks)

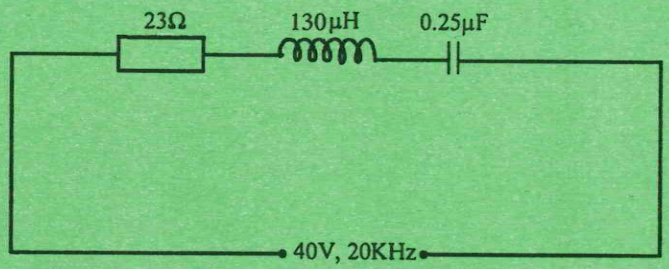

Fig. 5

(c) A 100 kVA, 400 V/200 V, 50 Hz single phase transformer has 100 secondary turns. Neglecting losses, determine the:

(i) secondary current, I_2;
(ii) primary current, I_1;
(iii) primary turns, N_1;
(iv) flux, Φ.

(8 marks)

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