2506/102
2507/102
AIRCRAFT ELECTRICAL
TECHNOLOGY
June/July 2023
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;
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 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 and*
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) (i) Distinguish between arc-flash and arc-blast with reference to aircraft electrical safety hazards.

(ii) Explain the dangers posed by each of the following to aircrafts:

(I) birds;

(II) mobile phones. (6 marks)

(b) Describe Ram Air Turbine (RAT) aircraft power source. (6 marks)

(c) With aid of a labelled diagram, describe an aircraft split-bus power distribution system. (8 marks)

2. (a) State two aircraft electrical installation hand tools. (2 marks)

(b) Describe each of the following aircraft lights:

(i) taxi;

(ii) anti-collision. (6 marks)

(c) (i) Distinguish between luminous flux and luminous intensity with respect to illumination.

(ii) A cabin crew room measuring 16 m x 10 m is illuminated to a level of 200 lux using a number of lamps with 3,000 lumens each. The utilization and maintenance factors of the lamps are 0.74 and 0.8 respectively.

Determine the total:

(I) lumens required in the room;

(II) lumens given by the lamps;

(III) number of lamps required. (8 marks)

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

(i) antenna;

(ii) electrolytic capacitor.

(4 marks)

3. (a) State **three**:

(i) benefits of structured cabling;

(ii) types of cables used in structured cabling.

(6 marks)

(b) Draw wiring diagram of a three-point lamp control using two, 2-way switches and **one** intermediate switch. (6 marks)

(c) With aid of a diagram, describe the operation of a magnetic tripping circuit breaker. (8 marks)

4. (a) Describe each of the following aircraft electrical diagrams:

(i) wiring;

(ii) block.

(4 marks)

(b) Explain how precipitation static charges are developed in an aircraft. (3 marks)

(c) (i) Figure 1 shows a crimping terminal connector lug. Identify the parts labelled 1, 2 and 3.

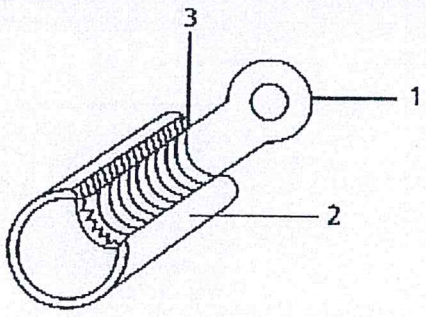

Fig. 1

(ii) State **three** merits of the cable termination method in c (i).

(6 marks)

(d) Figure 2 shows a circuit diagram of a thermo couple fire warning system used in aircrafts.

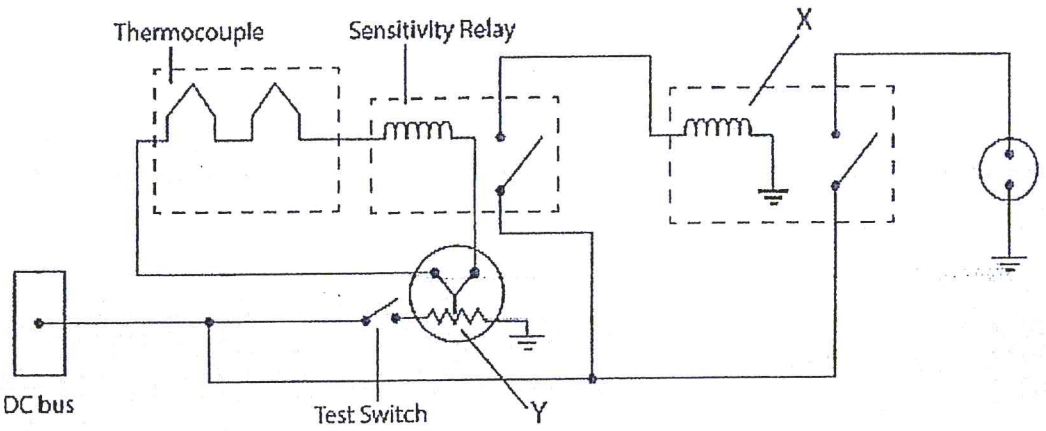

Fig. 2

(i) Identify the parts labelled X and Y;

(ii) describe its operation.

(7 marks)

5. (a) Describe the **two** methods of installing conduits in electrical installations. (6 marks)

(b) With aid of a labelled diagram, describe the protective multiple earthing (PME) system. (6 marks)

(c) (i) With aid of a labelled diagram, describe the operation of an ionization smoke detector used in aircrafts.

(ii) State **two** merits of photoelectric smoke detectors.

(8 marks)

SECTION B: ELECTRICAL ENGINEERING PRINCIPLES

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

6. (a) (i) Define each of the following electrical quantities:

(I) voltage;

(II) power.

(ii) A 0.24 m long copper cable carries a current of 1200 A. The potential difference between the two ends of the cable is 1.6×10^{-2} V. The resistivity of copper is 1.72×10^{-8} Ω m.

Determine the:

(I) resistance of the cable;

(II) diameter of the cable.

(8 marks)

(b) Figure 3 shows four cells connected in parallel across a 10 Ω resistor.

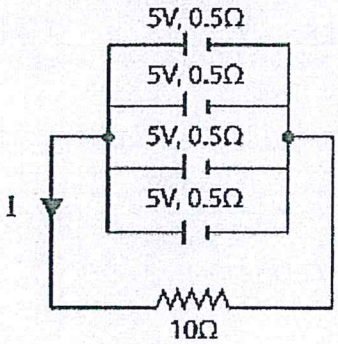

Fig. 3

Determine the:

(i) equivalent internal resistance;

(ii) total current;

(iii) current from each cell.

(6 marks)

(c) A moving iron instrument reads correctly a 250 V d.c. The instrument has a coil of resistance 500 Ω and inductance 1 H. A resistor of 200 Ω is connected in series with the instrument.

Determine the:

(i) full-scale deflection d.c current;

(ii) a.c impedance of the circuit;

(iii) reading when 250 V, 50 Hz a.c is applied.

(6 marks)

7. (a) State **three** types of capacitors used in aircraft electrical systems. (3 marks)

(b) Figure 4 shows a capacitive network.

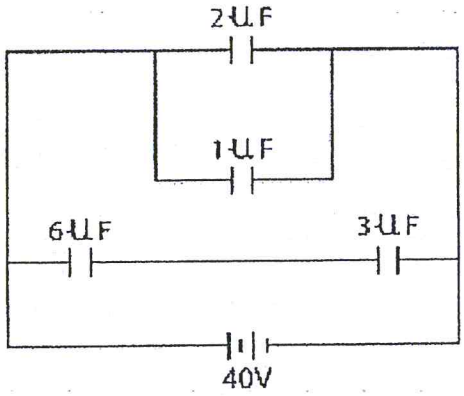

Fig. 4

Determine the:

(i) equivalent capacitance;

(ii) charge on the 1 μF capacitor;

(iii) voltage across the 6 μF capacitor.

(6 marks)

(c) Two coils of inductance 2 mH and 8 mH are kept close to each other. A current of 50 sin 500t amperes is passed in the 2 mH coil.

Determine the:

(i) mutual inductance of the coil;

(ii) peak value of the induced e.m.f;

(iii) instantaneous value of the induced e.m.f after 2 seconds.

(8 marks)

(d) List **three** factors that affect the mutual inductance between two coils. (3 marks)

8. (a) Describe each of the following transformer tests:

(i) open circuit;

(ii) short-circuit.

(6 marks)

(b) A single-phase transformer has 500 turns on the primary winding and 10 turns on the secondary winding. A voltage of 120 V is supplied on the primary winding and a 15 Ω resistive load is connected on the secondary winding.

Determine the:

(i) secondary voltage;

(ii) secondary winding current;

(iii) primary winding current.

(6 marks)

(c) A 500 μH inductor, 8.11 ρF capacitor and 628 Ω resistor are connected in series. A voltage of 12 V is applied across the circuit.

Determine the:

(i) resonant frequency;

(ii) Q-factor at resonance;

(iii) current flowing through the circuit at resonance.

(8 marks)

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