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:
  Mathematical tables;
  Non-programmable scientific calculator;
  Answer booklet.

This paper consists of TWO sections; A and B.
Answer Question 1 (compulsory) and TWO other questions from section A.
Answer TWO questions from section B.
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 6 printed pages.

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

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SECTION A: WORKSHOP TECHNOLOGY (60 marks)

Answer Question 1 (compulsory) and TWO other questions from this section.

1. (a) Outline three safety gears worn during aircrafts electrical installations. (3 marks)

(b) Describe the following aircraft safety hazards:

(i) use of mobile phones on aircraft take-off;

(ii) turbulence due to thunderstorms. (6 marks)

(c) Explain how to handle the following accidents:

(i) electrical burns;

(ii) shock. (8 marks)

(d) List three types of soldering techniques. (3 marks)

2. (a) List three tools used in aircraft electrical maintenance. (3 marks)

(b) Table 1 shows the state of aviation light signals at two different stages. Complete the table to indicate the action taken by the pilot.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Aircraft in flight</th>
<th>Aircraft on the ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashing green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady red</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(6 marks)

(c) Describe the following Radio Frequency (R.F) connectors:

(i) N-Series;

(ii) C-Series. (4 marks)

(d) With the aid of a circuit diagram, explain the operation of thermal switch fire detection system used in aircraft's alarms. (7 marks)

3. (a) Define the following terms:

(i) earth fault loop impedance;

(ii) fault current. (2 marks)
(b) Describe the following wiring systems:

(i) bus bars;
(ii) trunking. (6 marks)

(c) With the aid of a circuit diagram, describe the single pole earth return technique of earthing a three phase installation. (6 marks)

(d) A 4 mm² copper wire with a resistance of 0.0046 Ω/m is used to run a 7.5 kW single phase motor which draws 14 A from a 240 V supply. The circuit is a direct on line (D.O.L.) connected to 40 A circuit breaker whose rating is 7.5.

Take:
- resistance of the earth wire to be = 0.074 Ω/m;
- cable run is 100m.

Determine the:

(i) voltage drop along the cable;
(ii) short circuit current;
(iii) trip current. (6 marks)

4.

(a) Name two tools used in structured cabling. (2 marks)

(b) Describe the following call and alarm systems:

(i) ground proximity warning;
(ii) traffic collision avoidance system. (4 marks)

(c) With the aid of a diagram, describe each of the following topologies:

(i) mesh topology;
(ii) bus topology. (8 marks)

(d) The circuit diagram below show a type of earth leakage circuit breaker (ELCB).

(i) Identify parts labelled X,Y.
(ii) Explain its operation. (6 marks)

![Circuit Diagram]

Fig. 1
5. (a) Define the following with respect to Illumination:

(i) transmittance;
(ii) reflection ratio. (2 marks)

(b) Table 2 shows illumination concepts, complete the table.

<table>
<thead>
<tr>
<th>Concept</th>
<th>SI units</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminous Flux</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous Intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illuminance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(6 marks)

(c) A corridor is lit by 4 lamps spaced 10 m apart and suspended at a height of 5 m above the center line of the floor. Each lamp gives 200 candela power in all directions below the horizontal.

(i) Sketch the layout of the lamps;
(ii) Determine the illumination at the centre of the corridor due to:
(I) first lamp ($L_1$);
(II) second lamp ($L_2$). (8 marks)

(d) Explain the following types of luminaries used in aircraft installations:

(i) beacon;
(ii) strobe lights. (4 marks)

SECTION B: ELECTRICAL ENGINEERING PRINCIPLES (40 marks)

Answer TWO questions from this section.

6. (a) Table 3 shows electrical quantities, complete the table stating their SI units.

<table>
<thead>
<tr>
<th>Electrical quantity</th>
<th>S.I. units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Conductivity</td>
<td></td>
</tr>
<tr>
<td>(ii) Capacitance</td>
<td></td>
</tr>
<tr>
<td>(iii) Charge</td>
<td></td>
</tr>
</tbody>
</table>

(3 marks)
Figure 2 shows a circuit diagram with resistors of different combinations supplied from a potential difference (p.d) of 60V between points A to B.

![Circuit Diagram]

Fig. 2

(i) Determine the resistance between:
(I) A and C;
(II) ACD;
(III) A and D.

(ii) Determine the effective resistance. (8 marks)

(c) (i) With the aid of a diagram, explain the principle of operation of Lead Acid Battery.
(ii) List two methods used in battery charging. (9 marks)

7. (a) State Faraday’s laws of electromagnetic induction. (2 marks)

(b) A mild steel ring of 30 cm mean circumference has a cross-sectional area of 6 cm² and has a winding of 500 turns on it. The ring is cut through a point so as to provide an air-gap of 1 mm in the magnetic circuit. A current of 4 A in the winding produces a flux density of 1 Tesla in the air gap.

Determine the:

(i) field strength due to the air gap;
(ii) relative permeability;
(iii) field strength due to mild steel ring. (9 marks)

(c) (i) List three merits of permanent-magnet moving coil (PMMC) instruments.
(ii) With the aid of circuit diagram, describe the extension of the range of an Ammeter. (9 marks)
8. (a) Define the following with respect to a.c theory:

(i) cycle;
(ii) phase;
(iii) form factor. \( \text{(3 marks)} \)

(b) Explain the effects of the following passive elements in a.c circuits:

(i) inductor;
(ii) capacitor. \( \text{(6 marks)} \)

(c) (i) List two tests performed in a transformer.
(ii) A 30 kVA, 2400/120 – V, 50 Hz transformer has a high voltage winding resistance of 0.1 \( \Omega \) and a leakage reactance of 0.22 \( \Omega \). The low voltage winding resistance is 0.035 \( \Omega \) and reactance is 0.012 \( \Omega \).

Determine the:

(I) equivalent winding resistance;
(II) equivalent reactance;
for both primary and secondary side. \( \text{(11 marks)} \)

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