THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAMES AND ENGINES OPTION)

MODULE II

THEORY OF FLIGHT

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Mathematical tables/Non-programmable scientific calculator;
Drawing instruments;
Answer booklet.
*This paper consists of **EIGHT** questions.*
*Answer **FIVE** questions.*
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 3 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

1. (a) State **five** helicopter components. (5 marks)

   (b) Explain each of the following aerodynamic factors on the helicopter:

       (i) dissymmetry of lift;
       (ii) conning;
       (iii) traverse flow.

   (15 marks)

2. (a) Outline **five** variable factors that determine the static stability of an aircraft. (5 marks)

   (b) With the aid of labelled sketches, differentiate between aircraft yaw and sideslip angles. (6 marks)

   (c) With the aid of a labelled sketch, explain the effect of sweepback wing on an aircraft static directional stability. (9 marks)

3. (a) An aeroplane has a speed of 240 kts and a mass of 50,000 kg. Calculate the new speed and percentage decrease in mass for a mass of 40,000 kg. (4 marks)

   (b) With the aid of a labelled sketch, explain the gust load factor of an aircraft. (10 marks)

   (c) An aircraft is in a 30° coordinated turn at TAS of 180 kts. Assuming gravity is equal to 9.81 m/s² and 1 kt is equal to 0.515 mps, calculate the turn radius and rate of turn. (6 marks)

4. (a) Discuss each of the following variables that affect the aircraft climb performance:

       (i) altitude;
       (ii) mass;
       (iii) flap setting;
       (iv) wind component.

   (12 marks)

   (b) With the aid of sketches, describe an aircraft turn on climb and descent. (8 marks)

5. (a) With the aid of a labelled sketch, explain the function of wing leading edge flaps. (7 marks)

   (b) With the aid of sketches, differentiate between the operation of a krueger flap and drooped leading edge. (8 marks)

   (c) Outline **five** undesirable effects of high wind loading on aircraft take off and landing. (5 marks)

6. Discuss **four** main high drag devices used in increasing total drag to assist aircraft stop during a landing roll. (20 marks)

7. Given that:

    (a) thrust of a twin-engined turbojet aeroplane is 40,000 Newtons per engine. The minimum permissible climb gradient is 2.4% in still air. Assume gravity (g) is 10 m/s^2, and drag is 29,000 Newtons. Calculate the maximum permissible mass (in kg) of the aeroplane with one engine innoperative that will enable it to attain the minimum permissible gradient of climb; (5 marks)

    (b) total thrust available for a four engined turbojet aeroplane weighing 85,000 kg is 240,000 Newtons. Calculate the rate of climb of this aeroplane with one engine innoperative if the thrust required is 110,000 Newtons and the climbing speed is 190 kts. TAS. Assume gravity is 10 m/s^2. (5 marks)

    (c) With the aid of sketches, compare maximum angle of climb (Vx) and maximum rate of climb (Vy) airspeed. (10 marks)

8. Discuss each of the following aircraft dynamic instabilities:

    (a) spiral; (10 marks)

    (b) dutch roll. (10 marks)

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