2506/207
THEORY OF FLIGHT
March/April 2024
Time: 3 hours

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:
Answer booklet;
Drawing instruments;
Mathematical tables/Non-programmable scientific calculator.
*This paper consists of **EIGHT** questions.*
*Answer **FIVE** questions in the answer booklet provided.*
Maximum marks for each part of a question are as shown.
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) With the aid of a labelled sketch, describe the forces that act on an aircraft in a steady straight glide. (15 marks)

   (b) An aeroplane glides with the engine off at an airspeed of 80 knots, and is found to lose height at the rate of 1500 ft/min. Calculate the angle of glide. (Assume conditions of no wind) (5 marks)

2. Differentiate between each of the following with reference to aircraft stability.

   (a) Stick fixed and stick free static longitudinal stability. (6 marks)

   (b) Phugoid and short period oscillations. (14 marks)

3. With reference to helicopter aerodynamics, explain each of the following flow effects.

   (a) Transverse flow; (7 marks)

   (b) Ground effect; (7 marks)

   (c) Retreating blade stall. (6 marks)

4. (a) With the aid of labelled sketches, explain the principle of operation of a leading edge flap. (15 marks)

   (b) An aircraft of mass 150,000 kg has a stalling speed of 120 knots. Fuel usage decreases the mass of the aircraft to 120,000 kg. Determine the value of revised stalling speed. (5 marks)

5. With the aid of a labelled sketches, describe the effect of each of the following using designs on aircraft stalling speeds.

   (a) Elliptical; (3 marks)

   (b) Rectangular; (6 marks)

   (c) Tapered; (4 marks)

   (d) Swept back. (7 marks)

6. With reference to spin manoeuvres, discuss:

   (a) Fully developed spin; (10 marks)

   (b) Effect of position of centre of gravity; (5 marks)

   (c) Technique of recovery. (5 marks)

7. (a) An aircraft of mass 2000 kg has the centre of lift and the centre of gravity in the same vertical straight line when in normal cruising flight. If the thrust is 4.5 kN, and is 180 mm below the centre of drag, determine the force of the tailplane which is 6 m behind the centre of gravity. (7 marks)

(b) Calculate the force that is required on the tail plane of the aircraft in 7(a) if the centre of lift is shifted to 25 mm behind the centre of gravity. (7 marks)

(c) Highlight the information available from a manoeuvre envelop V-n diagram. (6 marks)

8. With the aid of labelled sketches, explain each of the following design features incorporated in an aircraft to enhance static lateral stability.

(a) Wing dihedral; (6 marks)

(b) Wing sweepback; (7 marks)

(c) High wing and low centre of gravity. (7 marks)

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