2506/207
THEORY OF FLIGHT
Oct./Nov. 2017
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:
Drawing instruments;
Mathematical tables/Non-programmable 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 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.

1. (a) With the aid of a labelled sketch of a propeller blade in flight, show all the angles, rotation speed and pitch. (8 marks)

(b) With reference to question 1(a) explain each of the following components in relationship to a propeller blade element in flight:

(i) forces;
(ii) angles;
(iii) rotational speed;
(iv) pitch.

(12 marks)

2. (a) With the aid of labelled sketches, differentiate between phugoid and short period oscillations instability modes. (14 marks)

(b) Explain dutch roll with respect to aircraft instability modes. (6 marks)

3. With the aid of sketches, describe the design characteristics and operation of each of the following lift augmentation devices:

(a) leading edge slats with flaperons. (10 marks)
(b) leading edge flaps. (10 marks)

4. (a) With the aid of a labelled sketch, explain the forces that cause an aircraft to change angle of bank and true air speed. (8 marks)

(b) Outline **four** effects on an aircraft if weight is increased in a steady horizontal level turn at the same angle of bank and airspeed. (8 marks)

(c) Explain **two** variations that determine the rate and radius of turn for an aircraft in flight. (4 marks)

5. (a) A private aircraft weighing 500 lbs has a wing area of 100 ft^2 and is in straight and level flight at a speed of 500 ft per second at sea level. If the coefficient of drag at zero lift, Oswald's efficiency and aspect ratio is 0.015, 6 and 0.6 respectively, determine the total drag. (8 marks)

(b) With the aid of a labelled sketch, determine the lift and the total drag if the aircraft in 5(a) was to steadily climb at 30°. (12 marks)

6. (a) With regard to helicopters, describe each of the following:

(i) main rotor head;
(ii) anti-torque rotor.

(4 marks)

(b) Describe the construction and operation of a gimbal mounted teethering rotor.

(6 marks)

(c) With the aid of labelled sketches, show how collective pitch variation is achieved on a helicopter. (10 marks)

7. (a) Describe the design characteristics of a rigid rotor used on helicopter, stating **three** advantages over an articulated rotor. (9 marks)

(b) With the aid of a labelled sketch, explain the cyclic actuation system arrangement between the cyclic stick and the fixed swashplate. (11 marks)

8. (a) Describe static longitudinal stability as applied on an aircraft in flight. (7 marks)

(b) With aid of labelled sketches, explain how each of the following design features provide the necessary lateral stability characteristics:

(i) high wing and low centre of gravity;
(ii) high keel and low centre of gravity.

(13 marks)

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