2506/302
FLIGHT MECHANICS
June/July 2018
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAMES AND ENGINES OPTION)

MODULE III

FLIGHT MECHANICS

3 hours

INSTRUCTIONS TO CANDIDATES

The candidate should have the following for this examination:
    Answer booklet;
    Drawing instruments;
    Mathematical table/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 sketches, describe the operation of a rate of climb indicator when the aircraft is:

    (i) level;

    (ii) descending;

    (iii) climbing.

    (10 marks)

    (b) Outline **four** factors that gyroscopic rigidity in space depends upon. (4 marks)

    (c) Illustrate the "T" arrangement of the basic flight instruments. (3 marks)

    (d) Calculate the true airspeed of an aircraft flying at 6,000 feet and speed at sea level is 204 knots. Take sea level density 1.225 kg/m^3 and 0.66 kg/m^3 at 6,000 m altitude. (3 marks)

2. With the aid of labelled sketches:

    (a) Show the difference between blow-through and induced flow type high speed wind tunnels; (10 marks)

    (b) Describe the flow pattern of airflow at supersonic speed on a thin plate placed at a small angle of attack. (10 marks)

3. (a) Differentiate between Subsonic and Supersonic flow on contracting and expanding ducts. (4 marks)

    (b) With the aid of sketches, explain why swept back wings are suitable at transonic speeds. (11 marks)

    (c) Outline **five** methods of protecting supersonic structure from heat. (5 marks)

4. With the aid of labelled sketches, describe the procedure for launching a spacecraft to the moon. (20 marks)

5. (a) An artificial satellite of mass 200 kg is travelling in an orbit round the equator. Given it is at a height of 36,000 km above the earth's surface calculate:

    (i) acceleration due to gravity;

    (ii) speed of motion;

    (iii) orbital period;

    (iv) weight of the satellite.

    (12 marks)

(b) Calculate the circular velocity and time taken by a satellite near the earth's surface.

(8 marks)

6. (a) Given the total drag of an aeroplane at 65 m/s is 4.22 kN and the power developed by the engine when it is flying at this speed is 336 kW. Calculate the efficiency of the propeller.

(6 marks)

(b) With the aid of labelled sketches, differentiate between the construction and operation of ram and pulse jet engines.

(14 marks)

7. (a) Outline **four** objectives of test flight in aeronautical engineering.

(4 marks)

(b) Highlight **six** major considerations during preparation phase of test flight.

(6 marks)

(c) Outline **five** checks done on each of the following manoeuvres during test flight:

(i) climbing;

(ii) approach.

(10 marks)

8. (a) When a sudden contraction is used in a horizontal pipe from 400 m to 200 m the pressure changes from 100 Kpa to 80 Kpa. If the coefficient of contraction for the jet is 0.62, find the discharge through the pipe.

(10 marks)

(b) A horizontal pipe of 200 m diameter suddenly enlarges to 300 m diameter. After some length, it suddenly reduces to 150 mm diameter. If water flowing in the pipe is 200 litres, determine the:

(i) loss of head due to sudden enlargement;

(ii) loss of head due to sudden contraction.

(10 marks)

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