THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
AIRFRAMES AND ENGINES OPTION

FLIGHT MECHANICS

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have the following for this examination:
    Mathematical tables / non-programmable scientific calculators;
    Drawing instruments.
Answer any FIVE of the EIGHT questions in the spaces provided in this question paper.
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
Candidates should answer the questions in English.

For Examiner's Use Only

Questions	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 20 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) Define each of the following terms as applied to missiles and satellites:

    (i)   earth satellites;
    (ii)   interplanetary vehicles;
    (iii) launch;
    (iv)   zone of influence;
    (v)   satellite launch window.

                                                                        (5 marks)

    (b) Discuss the **three** satellite re-entry methods.   (9 marks)

    (c) Show the events that take place if the speed of a body thrown vertically is progressively increased from rest to about 11 km/s at an appropriate height, direction and location.
                                                                        (6 marks)

2. (a) A Kenya Wildlife aircraft fitted with a turbojet engine with an inlet and exhaust area of 7 and 4.5 square feet respectively flies at 500 miles per hour at an altitude of 30,000 ft above the sea level where the air density is 0.0008906 lbs/In^2. If the inlet pressure and exhaust pressures are 629.66 and 640 lbs/ft^2 respectively, determine the engine thrust if the exhaust velocity is 1,600 ft/sec.   (10 marks)

    (b) Discuss ten reasons as to why the manufacturers must consider variation of the blade angle of an aircraft propeller during design.   (10 marks)

3. (a) Describe each of the following types of aircraft instability modes:

    (i)   spiral;
    (ii) roll subsidence.

                                                                        (10 marks)

    (b) Explain how each of the following design features enhance inherent aircraft stability:

    (i)   sweepback;
    (ii) keel.

                                                                        (10 marks)

4. With the aid of labelled sketches, describe each of the following with respect to helicopters:

    (a) torque reaction on a single rotor;   (2 marks)

    (b) rigid rotor head arrangement;   (9 marks)

    (c) airflow reversal.   (9 marks)

5.   (a)   Explain the importance of a test flight in aviation industry.   (4 marks)

     (b)   Explain what is accomplished by each of the following with regard to test flights:

           (i)   flight test phase;
           (ii)   ground testing.

                                                                            (6 marks)

     (c)   Highlight the mandatory checks that must be carried under each of the following before
           a trial test:

           (i)   general aircraft;
           (ii)   documentation.

                                                                            (10 marks)

6.   (a)   In an hydraulic system steady-state flow exists in a pipe that undergoes a gradual
           expansion from a diameter of 60" to 80". The density of the fluid in the pipe is constant
           at 50.21 bm/ft^3. If the flow velocity is 45.4 ft/sec in the 60" section, determine the flow
           velocity in the 80" section.   (7 marks)

     (b)   Differentiate between each of the following as applied to fluid flow:

           (i)   head and total head;
           (ii)   velocity and elevation head.

                                                                            (4 marks)

     (c)   With the aid of labelled sketches, compare between streamline and stream tube as
           applied in fluid flow.   (9 marks)

7.   (a)   Discuss the stages of intentional aircraft spin manoeuvre.   (8 marks)

     (b)   With the aid of a labelled sketch, explain the six degrees of freedom as applied in
           aircraft manoeuvre.   (12 marks)

8.   (a)   Discuss the effects of shockwave formation on a high speed aircraft.   (6 marks)

     (b)   Highlight **four** characteristics of super critical airfoils.   (4 marks)

     (c)   With the aid of a labelled sketch, discuss the formation of a bow shockwave on high
           speed aircrafts.   (10 marks)