2506/302
FLIGHT MECHANICS
June/July 2023
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

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 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 schematic diagram, explain the operation of an aircraft pneumatic gyro power systems. (14 marks)

   (b) Explain each of the following air speed limitations:

       (i) design maneuvering speed (VA);
       (ii) landing gear operating speed (VLO);
       (iii) best angle of climb speed (V_x);
       (iv) best rate of climb speed (VY);
       (v) single engine best rate of climb (VYSE);
       (vi) minimum control speed (VMC). (6 marks)

2. (a) An inverted U-tube Manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cm. When an oil of specific gravity 0.8 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted manometer are found to be same and equal to 35 cm. Using a labelled sketch, calculate the different of pressure between the pipes. (12 marks)

   (b) With the aid of sketches, differentiate between airflow over cylinder with and without circulation. (8 marks)

3. (a) With the aid of a labelled sketch, describe the design and flow over symmetrical biconvex aerofoil section. (10 marks)

   (b) Highlight **three** advantages and **two** advantages of using canard design. (5 marks)

   (c) Outline **three** functions of each of the following methods of using polymorphism:

       (i) tip droop;
       (ii) flowler flap. (5 marks)

4. (a) Highlight **seven** requirements of aerogas turbine engine combustion chambers. (7 marks)

   (b) With the aid of a sketches describe the construction of each of the following combustion chambers:

       (i) annular; (6 marks)

       (ii) multi-can. (7 marks)

5. (a) With the aid of a labelled sketch, discuss supersonic directional stability and highlight **two** methods of minimizing the instability. (12 marks)

   (b) With the aid of a sketch, explain the formation of shockwaves when the aircraft is flying below critical mach numbers. (8 marks)

6. (a) Differentiate between LEO and GEO satellites. (6 marks)

   (b) Given:

Mass of earth	=	5.97×10^{24}
Mass of Mars	=	6.40×10^{23}
Mass of Moon	=	7.34×10^{22}
Radius of earth	=	6.371×10^{6}
Distance of moon from earth =		3.84×10^{8}
Distance of Mass from earth =		0.78×10^{11}
Gravitational constant	=	6.67×10^{-11}

   Determine the:

   (i) acceleration due to gravity on the moon; (4 marks)

   (ii) speed of the earth, in the circular orbit about the sun. (4 marks)

   (c) With the aid of a labelled sketch, show the procedure of launching a spacecraft to the moon. (6 marks)

7. (a) Outline the details that flight test operations manual should define. (6 marks)

   (b) Highlight the safety manager's main responsibilities during aircraft test flight. (10 marks)

   (c) State **eight** safety features that the crew should be trained on before test flight. (4 marks)

8. (a) With the aid of a labelled sketch, describe the construction and operation of an attitude indicator. (14 marks)

   (b) Explain the function and operation of an inclinometer used on aircraft turn coordinators. (6 marks)

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