THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING AIRFRAMES AND ENGINES OPTION

FLIGHT MECHANICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

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.**

1. With the aid of labelled sketches, explain each of the following with respect to helicopter rotor blade in rotation:

    (a)   forces acting on a blade in rotation;   (9 marks)

    (b)   effects of blade lift and remedy.   (11 marks)

2. (a)   With the aid of a labelled sketch, describe the principle axis of an aircraft.
                                                                              (10 marks)

    (b)   Define the following terms as applied to aircraft stability:

          (i)   stick fixed;
          (ii)   stick free;
          (iii) longitudinal dihedral;
          (iv)   statically neutral systems.
                                                                              (4 marks)

    (c)   Explain how each of the following contributes to lateral stability:

          (i)   fin area;

          (ii)   high wing;
                                                                              (6 marks)

3. (a)   Explain the area rule as applied to the design of high speed aircraft.   (3 marks)

    (b)   With the aid of labelled sketches, explain compressive and expansive flow with reference to air at supersonic speed.
                                                                              (17 marks)

4. (a)   Differentiate between aircraft testing and flight test as applied in aviation.   (4 marks)

    (b)   Outline **eight** parameters that must be recorded during a test flight for a new aircraft.
                                                                              (8 marks)

    (c)   Explain **four** reasons for carrying out each of the following tests on a new aircraft:

          (i)   ground;

          (ii)   performance.
                                                                              (8 marks)

5. (a) Explain the meaning of each of the following terms as applied to fluid mechanics:

(i) velocity head;

(ii) total head.

(2 marks)

(b) With the aid a labelled sketch, explain the construction and operation of an orifice plate in fluid mechanics. (10 marks)

(c) Determine the velocity at the inlet of a scoop that has an inlet diameter and the outlet flow of 12 inches and 850 l bm/sec respectively, assuming the density of air is 32.2 l bm/ft³. (8 marks)

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

(i) dutch roll;

(ii) spiral mode.

(12 marks)

(b) Discuss the stages of an intentional aircraft spin manoeuvre. (8 marks)

7. (a) With the aid of a labelled sketch, describe the construction and principle of operation of a ram jet engine. (10 marks)

(b) With the aid of a labelled sketch, explain the various blade pitch positions that are associated with different constant speed propeller assemblies. (10 marks)

8. (a) Explain **three** reasons why the mass of a projectile used to propel bodies into space may decrease rapidly. (3 marks)

(b) Discuss a launch window with respect to space flight. (7 marks)

(c) With the aid of a labelled sketch, shows the correct circular orbits speed and time at different distances from the earth center. (10 marks)

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