2107/304
FLIGHT MECHANICS
June/July 2018
Time: 3 hours

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:
Answer booklet;
Mathematical tables/non-programmable scientific calculator;
Drawing instruments.
*Answer **FIVE** of the following **EIGHT** questions in the answer booklet provided.*
All questions carry equal marks.
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. (a) With the aid of a labelled sketch, describe a flapping hinge with respect to helicopters. (5 marks)

(b) With the aid of labelled sketches, explain **two** methods of achieving an even lift distribution along the rotor blade of a helicopter. (10 marks)

(c) Explain why lift dissymmetry may be natural or controlled in helicopters. (5 marks)

2. (a) Differentiate between positive static longitudinal stability and negative dynamic longitudinal stability. (4 marks)

(b) Discuss why an aircraft tends to return to the original slip angle during straight and level condition if the relative wind changes. (8 marks)

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

(i) sweepback;

(ii) keel. (8 marks)

3. (a) Outline **three** advantages and **three** disadvantages of using sweepback wings on high speed aircraft. (3 marks)

(b) With the aid of labelled sketches, explain the differences between a mach cone and mach line as applied in high speed flight. (17 marks)

4. (a) Describe the various tests carried out before an aircraft can be released for test flight under the following conditions:

(i) engine run;

(ii) systems;

(iii) controls. (11 marks)

(b) Describe the operational checks carried out from taxiing to take off climb on a piston driven aircraft after a major overhaul during a test flight. (9 marks)

5. (a) Define each of the following terms as applied in fluid mechanics:

(i) elevation;

(ii) pressure. (2 marks)

(b) With the aid of labelled sketches, explain the construction and operation of a venturi tube in fluid mechanics. (11 marks)

(c) Steady - state flow exists in a pipe that undergoes a gradual expansion from a diameter Y of 10 inches to a diameter Z of 64 inches. If the density of the fluid in the pipe is constant and the flow velocity is 35.5 ft/sec in section Y, determine the flow in section Z. (7 marks)

6. (a) Explain each of the following terms as applied in aircraft longitudinal modes:

(i) oscillating motions;

(ii) longitudinal motions. (4 marks)

(b) Describe each of the following types of aircraft instability modes:

(i) phugoid;

(ii) short period oscillations. (8 marks)

(c) Discuss each of the following aircraft manoeuvres:

(i) skid;

(ii) slip. (8 marks)

7. (a) Explain the principle of operation of a rocket engine. (10 marks)

(b) With the aid of labelled sketches, show the:

(i) operation cycle of a gas turbine engine;

(ii) construction of a fan engine. (10 marks)

8. (a) Highlight **three** values that change when the path of the space vehicle is changed by firing a retro-rocket to decrease the velocity and to enable curving towards the earth. (3 marks)

(b) With the aid of a labelled sketch, explain the effects of the earth's curvature when launching a spacecraft. (7 marks)

(c) Explain how a satellite may be launched into the orbit under the following headings assuming the earth is flat:

(i) launch;

(ii) increased speed. (10 marks)

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