

2506/302
FLIGHT MECHANICS
Oct./Nov. 2022
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN AERONAUTICAL ENGINEERING
(AVIONICS 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.

All questions carry equal marks.

Maximum marks for each part of a question are as indicated.

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) Outline **seven** advantages of a delta wing planform. (7 marks)
- (b) Highlight **four** methods in which area ruling can be achieved. (4 marks)
- (c) With the aid of a sketch, describe the features of a supercritical wing design. (9 marks)

2. (a) State **four** factors that determine the acceleration of an object re-entering the atmosphere. (4 marks)
- (b) With reference to space re-entry motion, explain the factors that determine each of the following:
 - (i) design requirements; (3 marks)
 - (ii) coordinate system; (3 marks)
 - (iii) assumptions; (2 marks)
 - (iv) ballistic coefficient. (2 marks)
- (c) Explain each of the following methods of space craft thermal-protection systems:
 - (i) heat sink;
 - (ii) spread ablation;
 - (iii) radiative cooling. (6 marks)

3. Discuss each of the following types of satellite orbits:
 - (a) geosynchronous; (2 marks)
 - (b) geostationary; (3 marks)
 - (c) polar; (6 marks)
 - (d) walking; (4 marks)
 - (e) sun synchronous. (5 marks)

4. (a) Explain the purpose of each of the standard colour-coded markings on the airspeed indicator. (9 marks)
- (b) With the aid of a labelled sketch, explain the operation of an aircraft heading indicator. (11 marks)

5. (a) With the aid of labelled sketches, differentiate between fixed shaft and free turbine turboprop engines. (11 marks)
- (b) With the aid of a labelled sketch, explain the principle of operation of a supersonic intake duct. (9 marks)
6. A 45° reducing bend is connected in a pipeline, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Calculate the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 , and the rate of flow of water is 600 litres/second. (20 marks)
7. Outline the precautions to be observed when conducting check flights on light aircraft during each of the following manoeuvres:
- (a) taxiing and engine run-up checks; (4 marks)
- (b) take-off and landing; (5 marks)
- (c) climbing. (11 marks)
8. With the aid of labelled sketches, describe the wave propagation for a point moving at each of the following speeds:
- (a) stationary;
- (b) sub-sonic;
- (c) sonic;
- (d) supersonic. (20 marks)

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