2506/302
FLIGHT MECHANICS
June/July 2019
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAME 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 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.

Turn over

1. Discuss how a space shuttle re-enters the atmosphere and lands. (20 marks)

2. (a) With reference to gyroscopes, explain each of the following terms:

    (i)   rigidity in space;
    (ii) precession.

    (4 marks)

    (b) With the aid of a labelled sketch, discuss the construction and principle of operation of the artificial horizon. (16 marks)

3. Discuss each of the following jet engine assemblies:

    (a) centrifugal flow compressor;   (10 marks)
    (b) turbine;   (6 marks)
    (c) combustion chamber.   (4 marks)

4. With the aid of labelled sketches, describe stall characteristics on thin wings under each of the following:

    (a) low speed stall;   (6 marks)
    (b) formation of a separation bubble;   (4 marks)
    (c) laminar flow separation;   (4 marks)
    (d) variation of critical angle of attack with free stream mach number. (6 marks)

5. Discuss the checks carried out during the execution of a flight test on a new aircraft before acceptance by a commercial aircraft operator. (20 marks)

6. (a) With the aid of labelled sketches, differentiate between a stream tube and a tube of flow with reference to fluid flow. (6 marks)

    (b) Discuss each of the following with reference to fluid flow:

    (i)   path lines;
    (ii)   time lines;
    (iii) streak lines;
    (iv)   stream lines.

    (8 marks)

    (c) Steady - state flow exists in a pipe that undergoes a gradual expansion from a diameter of 3 inches to a diameter of 11 inches. The density of the fluid in the pipe is constant at 40.6 m/ft^3. If the flow velocity is 56.7 ft/sec in the 3 inches section, determine the flow velocity in the expanded section. (6 marks)

7. (a) With the aid of labeled sketches, explain the behaviour of supersonic flow when it passes through each of the following:

(i)   convex corner;
(ii) shock wave.

(15 marks)

(b) With the aid of a labeled sketch, explain the effects of the change in free stream at the tip of sweepback wings. (5 marks)

8. (a) With the aid of a labelled sketch, explain Kepler's second law of planetary motion.

(6 marks)

(b) Explain how low polar orbit and geostationary artificial satellites are maintained in space. (9 marks)

(c) With the aid of a labeled sketch, show how the weight varies with increase in altitude compared to the weight on earth's surface. (5 marks)

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