

2506/304
GAS TURBINE ENGINE
March/April 2024
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAME AND ENGINES OPTION)

MODULE III

GAS TURBINE ENGINES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Drawing instruments.

*This paper consists of **EIGHT** questions.*

*Answer **FIVE** of the **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) Explain the function of each of the following key components of the gas turbine Full Authority Digital Engine Control.
- (i) electronic control units (ECUs);
 - (ii) actuators;
 - (iii) fault detection and diagnostics.
- (6 marks)
- (b) Describe the Brayton thermodynamic cycle as applied to the aero gas turbine engine. (8 marks)
- (c) Differentiate between a pulse jet and a rocket. (6 marks)
2. (a) (i) Outline **six** advantages of the modular construction of the aircraft gas turbine engine. (6 marks)
- (ii) Explain the **two** types of flow based on the behaviour of the fluid particles in a tube. (3 marks)
- (b) (i) Outline **three** requirements of a gas turbine engine's automatic fuel system. (3 marks)
- (ii) With the aid of a labelled cross-sectional sketch, show the construction of variable delivery engine driven fuel pump. (8 marks)
3. (a) With the aid of a labelled block diagram, explain the purpose of the aircraft gas turbine engine combustion chamber water injection system. (16 marks)
- (b) With reference to gas turbine engine exhaust system, outline each of the following:
- (i) convergent exhausts;
 - (ii) divergent exhausts;
 - (iii) convergent - divergent exhaust;
 - (iv) thrust reversal.
- (4 marks)
4. With the aid of a labelled schematic sketch, describe the flow of oil in an aero gas turbine full flow re-circulatory system. (20 marks)
5. (a) With the aid of sketches, describe each of the following types of labyrinth seals used in aircraft gas turbine engines.
- (i) screw back mechanical type;
 - (ii) screw thread mechanical type;
 - (iii) self clearing seals.
- (7 marks)
- (b) Explain the application of the free turbine in a turbo prop engine. (8 marks)
- (c) Outline the safety precautions observed while working on air craft gas turbine combustion chambers. (5 marks)

6.

With reference to aero gas turbine engine, describe the:

- (a) Construction and operation of the cartridge starting system; (5 marks)
- (b) Maintenance of the gas turbine ignition switch; (7 marks)
- (c) Construction and operation of the aircraft gas turbine engine reheat. (8 marks)

7.

(a) With reference to the aircraft gas turbine engine compressor surge, highlight six:

- (i) causes of compressor surge;
 - (ii) indications of compressor surge.
- (6 marks)

(b) (i) Describe the applications and performance characteristics of the gas turbine fire system. (8 marks)

- (ii) With the aid of a labelled sketch, show a typical two shot aircraft gas turbine fire system. (6 marks)

8.

(a) With reference to aircraft gas turbine engine instrumentation, explain the:

- (i) operation of the DC ratio-meter; (4 marks)
- (ii) seven key performance calculations; ($7\frac{1}{2}$ marks)

(b) Assuming that an aircraft gas turbine engine consumes 200 kg of fuel per hour and produces 50 kN of thrust, calculate the specific fuel consumption. (1 mark)

(c) Describe the functional checks carried out on the aero gas turbine engine ice protection system. ($7\frac{1}{2}$ marks)

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