

2107/306

AIRCRAFT PROPULSION

Oct./Nov. 2011

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAMES AND ENGINES OPTION)**

AIRCRAFT PROPULSION

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

*Answer booklet;
Drawing instruments.*

*Answer any **FIVE** of the **EIGHT** questions in this paper.
All questions carry equal marks
Maximum marks for each part of a question are as shown.
All dimensions are in millimetres.*

This paper consists of 4 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) Define each of the following forces in relation to the rotation of an aircraft propeller in flight:

- (i) centrifugal;
- (ii) torque bending;
- (iii) thrust bending;
- (iv) aerodynamic twisting;
- (v) centrifugal twisting.

(5 marks)

(b) With the aid of a sketch, explain the construction and operation of a constant speed propeller with a feathering provision during each of the following conditions:

- (i) over speeding;
- (ii) under speeding;
- (iii) changes in air density;
- (iv) failure.

(15 marks)

2. With the aid of a labelled cross-sectional and pressure volume diagrams, explain the operation of a single entry double stage centrifugal flow compressor of a turbo propeller aircraft engine. (20 marks)

3. (a) Explain each of the following aircraft sub-fuel systems:

- (i) idling;
- (ii) economizer;
- (iii) acceleration.

(6 marks)

(b) With the aid of a labelled diagrams, explain the construction and operation of an aircraft engine float type carburettor. (14 marks)

4. (a) Discuss the main functions of air cooling and sealing system in an aircraft gas turbine engine. (5 marks)

(b) Explain each of the following types of aircraft engine cooling and sealing systems:

- (i) low pressure;
- (ii) high pressure intermediate;
- (iii) high pressure.

(6 marks)

(c) With the aid of a sketch, explain the need for an aircraft engine generator cooling system. (9 marks)

5. (a) Outline **five** factors that make oil the most suitable fluid for lubricating aircraft engines. (5 marks)
- (b) Explain each of the following terms as applied to aircraft oil lubricating systems:
- (i) de-aeration;
 - (ii) inhibiting;
 - (iii) priming.
- (6 marks)
- (c) Illustrate a typical component layout of an aircraft engine pressure relief valve oil lubricating system. (9 marks)
6. (a) Outline **five** requirements of an aircraft engine inlet ducts. (5 marks)
- (b) Explain each of the following terms as applied to engine intakes:
- (i) anti-icing;
 - (ii) surge;
 - (iii) foreign object damage.
- (6 marks)
- (c) With the aid of sketches, discuss each of the following types of aircraft engine air intakes:
- (i) pitot;
 - (ii) external/internal compression;
 - (iii) divided.
- (9 marks)
7. (a) Outline **five** factors which determine the magnitude of thrust generated by an aircraft engine in flight. (5 marks)
- (b) Discuss each of the following terms as applied to an aircraft engine:
- (i) afterburner;
 - (ii) thrust reversal.
- (6 marks)
- (c) (i) Differentiate by formulae, the generation of thrust between static and flight conditions on aircraft turbo jet engine.
- (ii) An aircraft engine handles 200 lbs of air per second, while the velocity at the jet nozzle is 900 m.p.h. Determine the thrust when the aircraft is:
- (I) stationery;
 - (II) moving forward at 300 m.p.h.
- (9 marks)

8. (a) Outline the precautions to be observed when starting a high bypass gas turbine engine. (5 marks)
- (b) Explain each of the following methods of starting aircraft engines:
- (i) auxiliary power unit;
 - (ii) cartridge;
 - (iii) Iso-propyl-nitrate.
- (6 marks)
- (c) With the aid of sketches, explain the principle of operation of an aircraft engine magneto, showing magnetic flux at **three** positions of the rotating magnet. (9 marks)