2107/306
AIRCRAFT PROPULSION
Oct/Nov. 2010
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;
Mathematical Tables/Non-programmable calculator.
*Answer any **FIVE** of the following **EIGHT** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.

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) Explain each of the **three** design features of increasing the power absorbed by an aircraft propeller blade and in each case state the limitations. (6 marks)

(b) Differentiate between the following types of aircraft propellers:

(i) counter rotating and co-axial;
(ii) constant speed and feathering.

(8 marks)

(c) With the aid of line diagrams, compare the generation of thrust and reverse thrust on an aircraft propeller blade during flight. (6 marks)

2. With the aid of a cross-sectional sketch, explain the construction and operation of a triple spool front fan turbo-jet with a free turbine provision. (20 marks)

3. (a) Differentiate between the terms firing order and timing as applied to aeropiston engines. (4 marks)

(b) Explain the method used for computing the firing order of each of the following double-row radial aeropiston engines:

(i) 14-cylinder;
(ii) 18-cylinder.

(4 marks)

(c) With the aid of aeropiston engine value timing diagram, explain the operation of inlet and exhaust valves. (12 marks)

4. (a) Explain each of the following conditions which affect the engine performance in flight:

(i) forward speed;
(ii) altitude;
(iii) climate.

(6 marks)

(b) Use formulae to express each of the following terms as applied to aircraft jet engines:

(i) gross thrust;
(ii) momentum drag;
(iii) net thrust. (6 marks)

(c) (i) With the aid of graphs, show the relationship between propulsive efficiency and aircraft speed of each of the following types of turbo jet aircraft engines:

(i) turbo propeller;

(ii) high bypass;

(iii) low bypass;

(iv) pure jet.

(ii) Assuming an aircraft speed (V) of 575 mph and a jet velocity (V) of 2, 460 mph, determine the propulsive efficiency. (8 marks)

5. (a) Outline **six** design features of an aircraft engine fuel control system. (6 marks)

(b) Explain each of the following aircraft engine carburetion system:

(i) iddling;
(ii) accelerating;
(iii) economizer. (6 marks)

(c) With the aid of sketches, explain the method of varying a variable fuel pump output by kinetic valve. (8 marks)

6. (a) Outline the factors achieved by the design of a convergent/divergent propelling nozzle. (5 marks)

(b) With the aid of sketches, explain each of the following methods of obtaining thrust reversal on aircraft engines:

(i) cold stream;
(ii) hot stream;
(iii) negative pitch.

(15 marks)

7. (a) Outline the precautions to be observed in the application of lubricants in aircraft parts. (5 marks)

(b) Sketch the oil reservoir sight glass of a modern high bypass gas turbine engine and indicate the colours used. (5 marks)

(c) With the aid of sketches, differentiate between the following aircraft engine components:

(i) tank and reservoir;

(ii) non return valve and relief valve. (10 marks)

8. (a) Explain each of the following terms as applied to an aircraft engine combustion chamber performance:

(i) intensity;
(ii) efficiency;
(iii) stability. (6 marks)

(b) Discuss the combustion process in the aircraft engine combustion chamber. (5 marks)

(c) With the aid of sketches, describe each of the **three** types of combustion chambers. (9 marks)