

2506/207  
THEORY OF FLIGHT  
Oct./Nov. 2018  
Time: 3 hours



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

MODULE II

THEORY OF FLIGHT

3 hours

INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:*

*Drawing instruments;*

*Mathematical tables/Non-programmable scientific calculator.*

*This paper consists of EIGHT questions.*

*Answer FIVE questions in the answer booklet provided.*

*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) Describe each of the following aircraft manoeuvres and illustrate your answer with respect to a turn and slip indicator:
- (i) slipping;
  - (ii) skidding;
  - (iii) balanced.
- (9 marks)
- (b) With the aid of a sketch, explain the resolution of forces that act on an aircraft in a steady powered dive. (11 marks)
2. (a) With the aid of sketches, explain the **three** forms of dynamic stability. (11 marks)
- (b) Explain the factors that affect static longitudinal stability of an aircraft. (9 marks)
3. (a) Explain the effects of attitude on the performance of a propeller powered aircraft. (10 marks)
- (b) Calculate the velocity and power required when a weight of 10,000 N is added to an aircraft already weighing 50,000 N. (Assume a coefficient of lift of 1.2 at all angles of attack). (10 marks)
4. (a) Discuss the challenges of balancing the four forces acting on an aircraft in flight. (8 marks)
- (b) Given the following aircraft data:
- |   |   |                     |
|---|---|---------------------|
| Wing span                               | - | 29 m;               |
| Wing area                               | - | 70 m <sup>2</sup> ; |
| MTOW                                    | - | 19,950 kg;          |
| Maximum operating altitude              | - | 25,000 ft;          |
| Power rating of one engine              | - | 1,864 kW;           |
| Oswald efficiency factor                | - | 0.85;               |
| Ratio of jet thrust to propeller thrust | - | 0.15.               |
- Calculate the:
- (i) aspect ratio;
  - (ii) drag coefficient;
  - (iii) aircraft equivalent power at sea level conditions;
  - (iv) equivalent power at maximum operating altitude.
- (12 marks)

5. (a) Outline **five** helicopter controls. (5 marks)
- (b) With respect to question 5(a), explain the effects of the controls under each of the following headings:
- (i) function;
  - (ii) primary effect;
  - (iii) secondary effect.
- (15 marks)
6. With the aid of labelled sketches, explain the function and construction of each of the following:
- (a) leading edge slots; (8 marks)
- (b) (i) plain flap;  
(ii) split flap;  
(iii) slotted flap;  
(iv) fowler flap.
- (12 marks)
7. A jet aircraft with a mass of 6,000 kg has its line of thrust 150 mm below the line of drag. When travelling at high speed, the thrust is 18.0 kN and the centre of pressure is 0.5 m behind the centre of gravity. Calculate the load on the tailplane which is 8.0 m behind the centre of gravity. (20 marks)
8. Describe each of the following phases of spin:
- (a) incipient;
- (b) fully developed.
- (20 marks)

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