Reg. No. : | | | | | | | | | | | |

V 4502

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fifth Semester

Aeronautical Engineering

AE 1301 — FLIGHT DYNAMICS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the importance of International Standard Atmosphere?

2. Why SFC varies with velocity and altitudes?

3. What is the condition for minimum rate of sink and shallowest angle for powerless gliding flight?

4. What is meant by coordinated turn?

5. State two basic requirements of aircraft control system.

6. Define neutral point and briefly explain its significance in aircraft stability.

7. Graphically represent the criterion for directional static stability.

8. State two basic requirements of the rudder.

9. What is the effect of freeing the stick?

10. What is 'autorotation'?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Discuss different types of drag acting on the airplane. (8)

(ii) Explain drag polars of vehicles from low speed to high speed. (8)

Or

(b) (i) Derive condition for minimum thrust and power required in straight and level flight. (10)

(ii) Draw and explain power available and power required curves for both propeller and jet airplanes. (6)

12. (a) An airplane weighs 1,58,000 N and has a wing planform area of 90 m^2. Its drag polar is of the form $C_D = 0.015 + 0.08\,cm^2$. During cruise at an altitude of 3Km (ρ = 0.179 Kg/m^3) its engine suddenly fails and it is forced to descend down in a powerless glide. Calculate

(i) the minimum glide path angle

(ii) the maximum range covered over the ground

(iii) the equilibrium glide velocity at that altitude corresponding to minimum glide angle. (16)

Or

(b) Explain with sketches, pull up and push over maneuvers of flight and derive the expressions for turn rate and turn radius. (16)

13. (a) Write short notes on :

(i) Effects of fuselage and nacelle on static longitudinal stability. (8)

(ii) Discuss power effects on longitudinal stability of a jet aircraft. (8)

Or

(b) Explain :

(i) Elevator control power (5)

(ii) Stick force gradient (5)

(iii) Free elevator factor. (6)

14. (a) (i) Discuss dihedral effect. 5

(ii) Explain coupling between rolling and yawing. 5

(iii) Discuss Rudder lock. 5

Or

(b) Explain the following :

(i) Aileron reversal. (5)

(ii) Adverse yaw (5)

(iii) One engine inoperative condition. (6)

15. (a) Write short notes on :

(i) Phugoid motion (5)

(ii) Spiral and directional divergence. (6)

(iii) Routh's discriminant. (5)

Or

(b) Explain Dutch roll, auto rotation and spin. (16)

Reg. No. : | | | | | | | | | | |

R 3016

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fifth Semester

Aeronautical Engineering

AE 1301 — FLIGHT DYNAMICS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between troposphere and stratosphere.

2. What is parasite drag?

3. Define Range and Endurance.

4. How load factor is related to Bank angle?

5. State two basic requirements of aircraft control surface.

6. Distinguish between stability and controllability.

7. What is the need for aerodynamic balancing?

8. What is meant by weather cocking effect?

9. Define Aileron control power.

10. Explain the term stability derivative.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Show that elevator angle for trim is given by

$$\delta_{e_{trim}} = -\left[\frac{C_{m_0} C_{L_\alpha} + C_{m_\alpha} C_{L_{trim}}}{C_{m_\delta} C_{L_\alpha} - C_{m_\alpha} C_{L_\delta}}\right],$$ (5)

(ii) Discuss briefly the effect of compress bility and highly swept back wing on longitudinal stability. (5)

(iii) Discuss the advantages and disadvantages of CANARD configuration. (6)

Or

(b) (i) Derive an expression for the free elevator factor. (5)

(ii) Write short notes on stick force gradients. (5)

(iii) Discuss briefly how neutral point and maneuver point are determined from flight test. (6)

12. (a) Write short notes on :

(i) Rudder lock and dorsal fin. (8)

(ii) One engine inoperative condition. (8)

Or

(b) (i) Discuss the primary requirements of the rudder. (8)

(ii) Based on strip theory derive an expression for Aileron control power. (8)

13. (a) Describe how the lateral stability coefficients can be estimated.

Or

(b) Write short notes on :

(i) Spin and autorotation. (8)

(ii) Spiral divergence and Dutch Roll. (8)

14. (a) Discuss various types of drag in an airplane and methods of minimising the drag.

Or

(b) Derive the Brequette Range formula for a jet propelled airplane and discuss its implications.

15. (a) Show that for a propeller driven airplane the maximum rate of climb is given by $\left(\frac{R}{C}\right)_{max} = \frac{\eta_p P}{W} - \frac{2}{\rho}\sqrt{\frac{K}{C_{D_o}}}\left(\frac{W}{S}\right)^{1/2}\frac{1.155}{(L/D)_{max}}$

where η = propeller efficiency

P = Break Horse power.

Also discuss its implications.

Or

(b) In straight and level flight show that the velocity corresponding to minimum power required is 0.76 times the velocity corresponding to minimum thrust required.

C 3007

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fifth Semester

Aeronautical Engineering

AE 1301 — FLIGHT DYNAMICS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define skin friction drag and pressure drag.

2. What is ISA?

3. What are the conditions required for maximum drag and minimum power?

4. Explain the significance of 'load factor'

5. What is meant by 'degree of freedom' and how much required for airplane?

6. State two conditions for static longitudinal stability and indicate them with a plot.

7. Why do an airplane requires vertical tail?

8. Define angle of yaw and angle of sideslip.

9. What is porpoising oscillation?

10. Explain 'snaking mode'.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive an expression for variation of pressure in the 'STRATOSPHERE' region. (8)

(ii) Obtain the values of pressure, density and temperature at 5 km in ISA. (8)

Or

(b) (i) Derive the expression for drag polar and explain it with a neat plot. (6)

(ii) Draw the power required and power available curve for a jet engine and piston engine and state your observations. (10)

12. (a) (i) Derive the two equations given below and represent it graphically

$$D = AV^2 + \frac{B}{V^2}; P = AV^3 + \frac{B}{V}.$$

(ii) An aircraft weighing 25 kN has a wing area of 80 m² and its drag coefficient is $C_D = 0.016 + 0.04\,C_L^2$, calculate the minimum thrust required for straight and level flight, and the corresponding true air speed at sea level and at 10 km ($\sqrt{\sigma} = 0.58$). Calculate also the minimum power required and the corresponding true air speeds at the above conditions.

Or

(b) (i) Explain the significance of V-n diagram.

(ii) Obtain the expression for turn radius and turn rate for pull up and pushover maneuver.

13. (a) (i) Derive the expression for wing contribution to static longitudinal stability and offer your comments on this expression.

(ii) A wing body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric angle of attack $\alpha = -1.5°$. At $\alpha = 5°$ the C_L is measured as 0.52, the moment coefficient about the CG are measured as –0.01 and 0.05 for $\alpha = 1°$ and 7.88° respectively. The C.G. is located at 0.35 C. Calculate the location of the aerodynamic centre and the value C_M.

Or

(b) (i) What do you mean by stick fixed and stickfree longitudinal static stability? (6)

(ii) Explain about stickforce gradients. (5)

(iii) What is aerodynamic balancing? Explain. (5)

14. (a) (i) Describe Dihedral effect and aileron reversal. (8)

(ii) Discuss about adverse yaw and crosswind landings. (8)

Or

(b) Write short notes on :

(i) One Engine Inoperative condition (4)

(ii) Spin recovery (4)

(iii) Rudder lock (4)

(iv) Slip stream rotation of nose mounted propellers (4)

15. (a) (i) "The statically stable aircraft may be dynamically stable or unstable. Similarly dynamically stable aircraft may be statically stable or unstable". Are both statement true? Justify. (6)

(ii) Discuss various stability derivatives relevant to lateral dynamics. (10)

Or

(b) Write short notes on :

(i) Autorotation (6)

(ii) Dutch roll (5)

(iii) Spiral divergence (5)

T 8008

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Fifth Semester

Aeronautical Engineering

AE 1301 — FLIGHT DYNAMICS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What causes induced drag?

2. Plot the variation of power available with flight speed for a propeller powered airplane and indicate the effect of altitude on the curve.

3. Define service and absolute ceiling.

4. What are the conditions for maximum endurance of a jet powered airplane?

5. Define neutral point.

6. What is the criterion for static longitudinal stability?

7. What is meant by dihedral effect?

8. Differentiate between your and side slip angle.

9. Graphically represent a system which is statically stable but dynamically unstable.

10. What is spiral divergence?

PART B — (5 × 16 = 80 marks)

11. (a) An aircraft weighing 2,50,000 N has a wing area of 80 m^2 and its drag equation is $C_D = 0.016 + 0.04\ C_L^2$. Calculate the (i) minimum thrust required and (ii) minimum power required for straight and level flight

and the corresponding true air speed at sea level and at an altitude where $\sqrt{\sigma} = 0.58$. Assume sea level density to be 1.226 kg/m³.

Or

(b) While flying straight and level at [illegible] at a speed of 100 m/s, the pilot causes his aircraft to enter a horizontal, correctly banked circle of 1100 m radius while maintaining the same angle of incidence, the engine thrust being altered as necessary. Without altering either the incidence or the engine thrust, the pilot then brings the aircraft out of the turn and allows it to climb. Estimate the rate of climb if, at the angle of incidence $\frac{L}{D}$ ratio is 9.

12. (a) Write short notes on : (8)

(i) International standard atmosphere. (8)

(ii) Various types of drag of an airplane.

Or

(b) Write short notes on : (8)

(i) V-n diagram. (8)

(ii) Methods to minimize airplane drag.

13. (a) Discuss briefly the following : (8)

(i) Aerodynamic balancing of control surfaces.

(ii) Determination of neutral point and maneuver point from flight test. (8)

Or

(b) Discuss in detail the power effects on static longitudinal stability for a jet powered airplane.

14. (a) Discuss in detail the contribution of various components of the airplane on static directional stability.

Or

(b) Discuss briefly the following : (6)

(i) Basic requirements of the rudder. (5)

(ii) Aileron reversal. (5)

(iii) Adverse yaw.

15. (a) Discuss the following :

(i) Phugoid motion. (8)

(ii) Stability derivatives in longitudinal dynamics. (8)

Or

(b) Discuss in detail autorotation and spin and procedure for recovery from these situations.