

B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Sixth Semester

AERONAUTICAL ENGINEERING

AER115: Flight Dynamics

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

- _____ is a type of lift dependant drag.
 - Skin Friction Drag
 - Pressure Drag
 - Profile Drag
 - Induced Drag
- The lift co-efficient for minimum power condition is given by
 - $\sqrt{\frac{3C_{D0}}{K}}$
 - $\sqrt{\frac{C_{D0}}{K}}$
 - $\sqrt{\frac{C_{D0}}{3K}}$
 - $\sqrt{\frac{K}{C_{D0}}}$
- The altitude at which the $(R/C)_{max}$ equals to zero is called _____.
 - Absolute ceiling
 - Service ceiling
 - Normal ceiling
 - Adverse ceiling
- The lowest speed at which an airplane can maintain steady level flight is called _____.
 - Climb speed
 - Glide speed
 - Stall speed
 - Level speed
- An airplane wing of aspect ratio 8 and plan area 80 m². The aerodynamic mean chord of wing is _____.
 - 80/80
 - 8/80
 - $\sqrt{80/8}$
 - $\sqrt{8/80}$
- The recovery of an airplane from a dive or a glide is called a _____ maneuver.
 - Pull out
 - Pull down
 - Push in
 - Push out
- Airplane instability of 5% MAC. The pitching moment is 0.03 at a lift coefficient of 0.475. so that pitching moment at zero lift is
 - 0.0625
 - 0.625
 - 0.00625
 - 0.000625

- _____ are used to make the aircraft hinge moment zero by finer adjustment
 - Slats
 - Tabs
 - Slots
 - Spoilers
- Directional divergence can occur when the airplane does not posses _____.
 - Longitudinal stability
 - Lateral stability
 - Directional stability
 - Keel effect
- Dorsal fin making the aircraft, _____.
 - Laterally stable
 - Laterally unstable
 - Laterally stable and directionally stable
 - Laterally unstable and directionally stable

PART B (10 x 2 = 20 Marks)

- The power required in steady level flight decreases with altitude. True/False. Justify your answer. (Assume the airplane maintains its angles of incidence)
- Define SFC, and write down its importance in performance estimation
- Define Gliding.
- Show that the $C_L \text{ min.drag} = \sqrt{(C_{D0} / k)}$ with reference to $C_D = C_{D0} + K C_L^2$
- Describe the "ground effect on take-off"?
- Discuss the importance of maneuver point in V-n diagram?
- Define neutral point and static margin.
- Why the airplane is considered as a dynamic system in six degrees of freedom?
- Define power of lateral or aileron control.
- What is meant by weather cock effect?

PART C (5 x 14 = 70 Marks)

- a) Explain in detail about
 - International Standard Atmosphere (ISA) (7)
 - Drag Polar of an airplane and its significance (7)

(OR)

- Find out the total drag of an aircraft at a speed of 320kmph for which the total drag coefficient is given by $C_D = 0.0293 + 0.0398C_L^2$. (7)
 - In straight and level flight show that the velocity corresponding to minimum power condition is 0.76 times the velocity corresponding to minimum thrust required condition. (7)

22. a) (i) A sailplane weighs 4500 N and has a wing loading of 600 N/m². Its drag polar equation is $C_D = 0.010 + 0.022 C_L^2$ after completing a launch at 350 m in still air, what is the greatest distance the sailplane can cover, and what is the greatest duration of flight possible, assuming in both cases flight over level ground? Find the corresponding speeds of flight. Ignore the changes of density of atmosphere (10)
- (ii) Briefly explain about climb hodograph (4)

(OR)

- b) Discuss in detail about the importance of power available and maximum velocity (V_{max}) of Turbo jet and propeller driven aircrafts with appropriate sketch.

23. a) (i) Derive the equation of motion for a Pull up and Pull down maneuver with a neat sketch. (8)
- (ii) Explain the different phases of take-off flight with neat sketch? (6)

(OR)

- b) How does true airspeed differ from equivalent airspeed? Show the importance of equivalent airspeed for V-n Plot. Explain the corner points for their significance and importance in the aerodynamic/structural considerations during the life cycle of an airplane.

24. a) Derive the equations of motion of an airplane constrained to the plane of symmetry at constant speed and also derive the characteristic equation of an airplane dynamics. Discuss the solutions.

(OR)

- b) (i) List out the criteria for longitudinal static stability. Derive an expression for the wing contribution to the pitching moment of an aircraft about centre of gravity (8)
- (ii) Explain with neat sketches the various types of aerodynamic balancing of a control surface. (6)

25. a) Explain in detail about following with appropriate sketches (5)
- (i) Dutch Roll (5)
- (ii) Spiral instability (5)
- (iii) Autorotation & spin

(OR)

- b) Based on strip theory derive an expression for aileron control power.
