B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fifth Semester

Aeronautical Engineering

AE 2301/AE 51/10122 AE 501 — FLIGHT DYNAMICS

(Regulation 2008/2010)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is ISA?

2. What is the difference between profile drag and pressure drag?

3. What is service ceiling?

4. What is the use of V-n diagram?

5. How is longitudinal stability achieved in the aircraft?

6. What is stick force gradient?

7. Why is there a coupling between roll and yaw moment?

8. What is weather cocking effect?

9. Explain dynamic stability with an example.

10. How is autorotation initiated?

11. (a) (i) Explain the drag reduction techniques. (8)

      (ii) Derive the expression for drag polar and explain it with a neat plot. (8)

Or

  (b) Draw and explain the power required and power available curves for a jet engine and piston engine airplanes. (16)

12. (a) Derive the Breguet range equation for a jet engine aircraft and discuss its implications. (16)

Or

  (b) An airplane weighs 158000 N and has a wing plan form area of $90\,m^2$. Its drag polar is of the form $C_D = 0.015 + 0.08\,C_L^2$. During cruise at an altitude of 3 km $\left(\rho = 0.179\ kg/m^3\right)$ 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)

13. (a) (i) Discuss the power effects on longitudinal static stability for a jet airplane. (10)

      (ii) Explain briefly about any two methods of aerodynamic balancing of controls. (6)

Or

  (b) Derive the expression for wing contribution to static longitudinal stability, and offer your comments on this expression. (16)

14. (a) (i) Write short notes on: Aileron reversal and Dihedral effect. (8)

      (ii) What is the condition that has to be followed for one engine inoperative condition? (4)

      (iii) Discuss about Rudder lock. (4)

Or

  (b) (i) Based on strip theory derive an expression for aileron control power. (12)

      (ii) Discuss briefly about rudder requirements. (4)

15. (a) (i) Discuss various stability derivatives relevant to longitudinal dynamic stability. (10)

(ii) Discuss about autorotation and spin. How can the pilot recover from them? (6)

Or

(b) (i) Explain Spiral divergence and Dutch roll. (10)

(ii) A statically stable aircraft can be dynamically stable or unstable. Give the dynamic conditions under which it happens. (6)