CBCS SCHEME

USN | | | | | | | | | | |

21AE/AS54

Fifth Semester B.E. Degree Examination, June/July 2024
Aircraft Performance and Stability

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With neat diagram, derive the expression for power required and condition for minimum power required. **(10 Marks)**

b. Plot the thrust required curve and prove graphical approach is equal to analytical approach with the following data:
Flying altitude : 10 km
Maximum Take-off weight : 3,00,000 N
Wing plan form area = 90 m^2
Aspect ratio = 6.9
Parasite drag coefficient, $C_{D_0} = 0.015$, K = 0.08
Atmospheric density at 10 km = 0.5 kg/m^3 **(10 Marks)**

OR

2 a. With graphical approach, explain:
(i) Power available and power required
(ii) Thrust available and thrust required **(10 Marks)**

b. Discuss with graphs the equation for sink rate and time to glide. **(10 Marks)**

Module-2

3 a. Derive the condition and the velocity associated with $\left(\frac{C_L^{1/2}}{C_D}\right)_{max}$. **(10 Marks)**

b. Derive Breguet Range and Endurance equation for propeller engine aircraft. **(10 Marks)**

OR

4 a. Consider Gulfstream IV aircraft flying at 8 km altitude. Estimate the maximum range and endurance at this altitude. Consider the following conditions:
Maximum usable fuel weight = 1,30,000 N
Thrust specific fuel consumption = 3.05 N/hr-N
Weight of the aircraft = 3,25,000 N
Wing plan form area = 88 m^2
Aspect ratio = 5.92
Air density = 0.65 kg/m^3
Drag polar, $C_D = 0.014 + 0.07\ C_K^2$ **(10 Marks)**

b. Derive Breguet range and endurance equation for jet engine powered aircraft. **(10 Marks)**

Module-3

5 a. With neat diagram explain ground effects on a typical passage aircraft. **(10 Marks)**

b. Explain level turn in a steady flight and with neat diagram, derive an equation for turn radius. **(10 Marks)**

OR

6 a. With neat diagram, explain V-n diagram for a passenger aircraft. **(10 Marks)**

b. Explain in detail the pull-up and pull-down maneuvers of steady aircraft with appropriate equations. **(10 Marks)**

Module-4

7 a. With neat diagram, bring out the differences between absolute angle of attack and geometric angle of attack. **(06 Marks)**

b. Derive the necessary and sufficient condition for longitudinal static stability. **(08 Marks)**

c. Discuss the salient features of Wright flyer 1. **(06 Marks)**

OR

8 a. Prove that static margin is the direct measure of static longitudinal stability of the airplane. **(10 Marks)**

b. A wing body model is tested in a subsonic wind tunnel. The lift is found to be zero at geometric angle of attack $-1.5°$. At $5°$ geometric angle of attack, the lift coefficient is measured as 0.52. Also at $\alpha = 1°$ and $7.88°$, the moment coefficient is measured as -0.01 and 0.05 respectively. The CG is located at 0.35C. Calculate the location of aerodynamic centre and the value of $C_{M,ac_{wb}}$. **(10 Marks)**

Module-5

9 a. Derive equations for stick-free neutral point. **(08 Marks)**

b. Explain any three methods of aerodynamic balancing. **(06 Marks)**

c. Explain the effect of wing dihedral to the lateral stability of the aircraft. **(06 Marks)**

OR

10 a. Explain the contribution of wing position and vertical stabilizer on the lateral stability of the aircraft. **(10 Marks)**

b. With neat diagram, explain Rudder lock and also discuss a method to overcome rudder lock. **(10 Marks)**

* * * * *