



Reg. No. :

Name :

**First Semester M.Tech. Degree Examination, February 2015
(2013 Scheme)**

Branch : Electrical and Electronics Engineering

EGC 1002 : INTRODUCTION TO FLIGHT

Stream : Control Systems & Guidance and Navigational Control

Time : 3 Hours

Max. Marks :60

- Instructions :** i) Answer **any two full** questions from **each** Module.
ii) **All** questions carry **equal** marks.
iii) Standard atmosphere table in **both** systems of units is to be **allowed**.
iv) Graph paper may be **supplied**.

MODULE – I

1. a) What is meant by aerodynamics ? Sketch the aerodynamic flows at various range of Mach numbers and explain.
b) Derive the expression for the variation of pressure and density in gradient layer.
c) If the sea level pressure and temperature are 100500 N/m^2 and 20°C respectively, while at certain unknown altitude the pressure is 71800 N/m^2 and temperature is -10°C , is the atmosphere between these altitudes stable or unstable ? Calculate the height at which the second pair of readings were taken. Assume a linear variation of temperature with altitude.
2. a) Describe the circulation theory of lift.
b) Derive the expression for the Reynold's number from fundamentals of fluid dynamics.
c) A flat plate of 1 ft length placed in a wind tunnel test section is being tested at 150 ft/s and 300 ft/s at standard sea-level conditions. If the critical Reynold's number is 5×10^5 , find the locations at which flow transitions takes place ? Take $\mu = 3.737 \times 10^{-7} \text{ slug/ (ft.s)}$, $\rho = 0.00238 \text{ slug/ft}^3$.





3. a) Write a note on dynamic pressure and aerodynamic heating.
- b) Derive the expression for induced drag.
- c) Derive the PI terms for Reynold's number and Mach number using Buckingham's PI theorem.

MODULE – II

4. a) Write a note stalling of airfoils.
- b) Distinguish between aerodynamic center and centre of pressure. How do they vary with angle-of-attack ? Explain.
- c) For a given airfoil section, the pitching moment co-efficient about a spindle $1/3$ chord behind the leading edge varies with lift co-efficient as given below

C_l	0.2	0.4	0.6	0.8
C_m	- 0.02	0.0	0.02	0.04

Find the aerodynamic center and the value of c_{m0} .

5. a) Write a note on NACA airfoils.
 - b) Write a note on Mach number independence.
 - c) A fighter aircraft is flying with $M = 2.5$ at a geometric altitude of 1100 m. Estimate the time lapsed between the instant the aircraft was directly above an observer and the instant the observer feels the disturbance due to the aircraft when the observer is stationary.
6. a) Describe flow similarity and similarity parameters.
 - b) What is meant by drag polar ? Explain.
 - c) A Boeing 747 airliner cruising at a velocity of 550 mi/hr at a standard altitude of 38000 ft, where free stream pressure and temperature are 432.6 lb/ft^2 and 390°R respectively. A one-fifth scale model of the aircraft is tested in a wind tunnel where the temperature is 430°R . Calculate the required velocity and pressure of the test airstream in the wind tunnel such that the lift and drag co-efficients measured for the wind tunnel model are same as for free flight. Assume both μ and a are proportional to $T^{1/2}$.



MODULE – III

7. a) Write notes on the control surfaces of an aircraft. Draw the block diagram of pitch autopilot.
b) What is the function of flap ? Explain any three types of flap.
c) The wing geometry of a space shuttle is approximated by a swept trapezoidal wing. The root chord for the wing is 57.4 ft and the tip chord is 11.5 ft. The wing span is 78.6 ft. Calculate the wing area, aspect ratio, taper ratio for the wing.

 8. a) Explain the terms swept wing, dihedral angle and canard.
b) Write a note on the longitudinal static stability of an aircraft.
c) An airplane of 10000 kg mass is designed with the line of thrust 0.9 m above the line of drag. In normal flight the drag is 18.2 N and the center of pressure on the main plane is 150 mm behind the center of gravity. If the center of pressure on the tail plane is 10 m behind the center of gravity, what is the load on the tail plane ?

 9. a) What are static and dynamic stability of an aircraft ? Explain.
b) Write notes on launch vehicles and UAVs.
c) Write a note on missiles.
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