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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**
FIRST SEMESTER M.TECH DEGREE EXAMINATION DECEMBER 2015
**Electrical and Electronics Engineering**
(Control Systems & Guidance and Navigational Control)
**01EE6203: Introduction to Flight**

Time: 3 hours                                                                              Max: Marks : 60

**Instructions:**     i) Standard atmosphere tables in both systems of unit is allowed
                          ii) Answer **any TWO FULL** questions from each **PART**

### Part A (Module I and II)

1  a)  Derive the expression for pressure and density variation in the stratosphere     (4)

   b)  The temperature from sea level to an altitude of 30000ft is found to decrease in a     (5)
       linear manner. The temperature and pressure at sea level are measured to be 40°F
       and 2050lb/ft² respectively. If the temperature at 30000ft is -60°F, find the
       pressure and density at 20000ft

2  a)  Derive the stability conditions of the atmosphere.  What is meant by lapse rate?     (5)

   b)  Write notes on boundary layers     (4)

3  a)  What is Mach number? Derive expression for the dynamic pressure $q = \frac{1}{2}\gamma p M^2$     (4)

       Sketch the aerodynamic flow fields around an airfoil for subsonic and supersonic
       flight regimes.

   b)  An airplane is flying at a Mach number of 2 at an altitude of 30,000ft. If the     (5)
       characteristic length for the airplane is 12ft, determine the Reynolds number for
       the flight condition. The co-efficient of viscosity at this altitude is
       $\mu = 3.11 \times 10^{-7}$ (lbf.s/ft²)

### Part B (Module III and IV)

4  a)  Derive the expression for vorticity in a flow field     (5)

   b)  State and explain Buckingham PI theorem     (4)

5  a)  The wing geometry of a space shuttle has a swept , trapezoidal shape  with root     (4)
       chord length 57.4 ft and tip chord length 11.5ft. The  wing span is 78.1ft.
       Calculate the aspect ratio

   b)  Explain the mathematical and physical methods of generation lift in an air foil?     (5)

6 a) Show that the speed of sound is proportional to $\sqrt{T}$ where T is temperature (4)

b) An aircraft is cruising at its assigned altitude at a Mach number of 0.85. The ambient air has a temperature of 232°K. At a point on the upper surface of the wing, the pressure is measured to be 20100N/m² and temperature is 221°K. The flow over the wing is isentropic. How much lift per square meter is generated on the upper surface at this point? What is velocity of the airplane (5)

## Part C (Module V and VI)

7 a) What is meant by flow similarity? Explain (4)

b) Write a note on Mach number independence. (4)

c) An aircraft is cruising at a velocity of 550 miles/hour at a standard altitude of 38,000 ft. An 1/50$^{th}$ scale model of the aircraft is tested in a wind tunnel where the temperature is 430° R. Calculate the velocity and pressure needed for the test airstream inside the wind tunnel such that the lift and drag co-efficients measured for the wind tunnel model are the same as for free flight . Assume the co-efficient of viscosity and the speed of sound are proportional to the square root of the temperature. (4)

8 a) What is meant by drag polar? Explain (4)

b) Show that the Mach angle $\mu = \tan^{-1}\left(\dfrac{1}{\sqrt{M^2-1}}\right)$ (4)

c) A jet aircraft being 13000lb has the line of thrust 0.5 ft below the line of drag. When flying at high speed the thrust is 4,000 lb and the center of pressure is 1.5 ft behind the center of gravity. What is the load on the tail plane which is 25 ft behind the center of gravity (4)

9 a) Write a note on any three types of aerospace vehicles (6)

b) Write notes on flaps, slc **http://www.ktuonline.com** (6)