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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2017
Electrical Engineering
(Guidance and Navigational Control, Control Systems)
01EE6203 Introduction to Flight

Max. Marks : 60

Duration: 3 Hours

Answer any two full questions from each Part. Standard Atmospheric Tables can be used

Part A

1.
 - a. What is meant by standard atmosphere? Derive the pressure and density variation in the gradient layer of the atmosphere.
 - b. Define temperature, density and pressure altitudes and explain their significances in flight dynamics.
 - c. An airplane is flying at a standard altitude of 5 km with a velocity of 270 m/s. At a point on the wing of the airplane, the velocity is 330 m/s. Calculate the pressure at this point. [4+3+2=9]
2.
 - a. What is meant by stable atmosphere? Derive the stability conditions of the atmosphere.
 - b. Define aerodynamic flow. Explain how aerodynamic flow is classified based on flow regimes.
 - c. The pressure and temperature at certain unknown altitude are measured to be 71800 N/m² and -10° C. Investigate the stability of the atmosphere between MSL and the unknown altitude. Also compute the unknown altitude. Assume a linear variation of temperature with altitude. [4+3+2=9]
3.
 - a. Define Mach number. How do flight regimes classified based on Mach numbers?
 - b. Consider an airplane flying with a velocity of 70 m/s at a standard altitude of 4 km. At a point on the wing of the airplane, the airflow velocity is 80 m/s. Calculate the pressure at this point. Assume incompressible flow.
 - c. What is meant by boundary layer? What causes boundary layer separation? Distinguish between laminar and turbulent flows. [3+3+3=9]

Part B

- 4.
- Explain vorticity and circulation. How are they related?
 - What is meant by aerodynamic heating? Discuss the consequences.
 - State and explain Buckingham Pi theorem. [3+3+3=9]
- 5.
- How lift is generated in an aircraft? What are the various factors that affect lift? Explain their effects.
 - Sketch the lift curve, drag curve and lift-drag ratio curve. What is the importance of L/D ratio?
 - What is meant by stalling? What are the causes of stall? Explain stall recovery procedure. [3+3+3=9]
- 6.
- With the help of a diagram explain the nomenclature of an airfoil.
 - Give detailed account of NACA series of airfoils with typical examples. Also give their specifications. [3+6=9]

Part C

- 7.
- What are aerodynamic coefficients? Discuss the effect of angle of attack on aerodynamic coefficients.
 - Distinguish between centre of pressure and aerodynamic centre. How do they vary with angle of attack?
 - Define Mach number, Critical Mach number and Drag divergence Mach number. What is Mach number independence? [4+4+4=12]
- 8.
- What is wind tunnel? What are the different types of wind tunnels? Explain the operation of any one type of wind tunnel with a suitable sketch.
 - Write notes on the control surfaces of an aircraft.
 - What is meant by high lift devices? What are the different types of high lift devices? Explain their actions. [6+3+3=12]
- 9.
- What is drag polar? Obtain an expression for drag polar and explain its feature with necessary sketches.
 - Describe flow similarity and similarity parameters.
 - Give an account of the general classification of aerospace vehicles. [4+4+4=12]