Code No: 45045 **R07** **Set No - 1**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
FLIGHT MECHANICS-I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Write down a differential equation for determining the ground roll distance during the landing phase of an airplane in terms of the landing weight, gross wing area, constants of the drag polar, maximum lift coefficient, braking friction coefficient of the runway, density of air, and the lift coefficient (assumed constant during the ground run). Make necessary assumptions.
   (b) What is side slip of an airplane? What do you understand by a coordinated turn of an airplane? What is the need for coordination? Explain how the turn and sideslip indicator assists the pilot in the execution of a coordinated turn. [10+6]

2. Describe for Skin friction drag of an airplane
   (a) The physics of its generation,
   (b) How it may be estimated
   (c) Measures to be taken for its reduction and
   (d) What the favorable and also adverse effects of the measures at 'c' above on the performance of the aircraft will be. [4×4]

3. For a piston engine driven propeller powered low subsonic airplane, it is desired that the stalling speed at sea level be decreased by 10%. Assuming that this should be achieved solely through changes in the aerodynamic design of the wing,
   (a) Propose the required changes and their extent (in percentage) in any two aerodynamic characteristics of the airplane by which the above objective may be most effectively achieved and thereby
   (b) Identify the required changes in the corresponding geometrical parameters of the wing / aerofoil.
   (c) Discuss how the proposed measures can meet the desired objective and also how they may adversely affect the performance of the airplane in other respects. [8+4+4]

4. (a) Derive an expression for ROC(rate of climb) and TOC(time of climb) for accelerated flight.
   (b) Consider a/c flying with instantaneous acceleration of 5 m/s^2 at a instantaneous velocity of 500 m/s, excess power is 200 m/s. Calculate the instantaneous minimum rate of climb that can be obtained at the accelerated flight conditions.

   [8+8]

5. (a) Classify the different flight regimes with neat sketches, with reference to Mach number.
   (b) What are the flow conditions before and after an expansion wave? Draw neat sketches. [8+8]

6. With the help of a sketch of a $C_L - \alpha$ curve, describe the effect of the following on the stall characteristics (maximum lift coefficient, stalling angle of attack, steepness of stall) of a wing
   (a) Trailing edge flap
   (b) Leading edge flap
   (c) Leading edge slot
   (d) Boundary layer control by suction. [4 × 4]

7. Derive the angular acceleration terms, gyro precession terms, and coupling terms acting on a rigid body. [16]

8. (a) Describe the long range cruise trajectory of missiles. What are the performance parameters to be estimated? Explain the procedure in brief for the following:
      i. time of climb
      ii. rate of climb
   (b) Explain in detail about the wing control and jet control employed for a missile. [8+8]

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