Code No: 45045 **R07** **Set No - 4**

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) Describe the significance of the following aerodynamic characteristics (parameters) in the context of the performance of an airplane.
   i. Minimum drag coefficient.
   ii. Lift coefficient corresponding to minimum drag coefficient
   iii. Range of lift coefficient over which the minimum drag coefficient is substantially constant (width of the drag bucket)
   (b) Name two geometric parameters of a wing that most significantly affect its 'induced drag' and describe how. [12+4]
2. What is a trajectory? Explain the different types of trajectories in detail. [16]
3. Explain:
   (a) Newton's second law of motion
   (b) Coriolis acceleration
   (c) Moments of inertia and Products of inertia
   (d) Euler angles. [2+4+4+6]
4. (a) Explain and derive expression for energy height and specific excess power
   (b) Consider an a/c flying with instantaneous acceleration of 3 m/s^2 at an instantaneous velocity of 300 m/s, excess power is 100 m/s. Calculate the instantaneous minimum rate of climb that can be obtained at the accelerated flight conditions.
   [8+8]
5. (a) Assuming that the thrust is much larger than the drag and ground friction on the aircraft during take off, estimate the percentage of the total increase (or decrease) of the distance of ground roll for take off on account of 1% increase each in the
   i. Take off weight and
   ii. Take off thrust of the aircraft.
   (b) For an airplane in steady, coordinated turn, derive an equation for the radius of turn in terms of the normal load factor, lift coefficient and wing loading. [8+8]
6. (a) Discuss the effect of Mach number on

i. The zero lift pressure drag of an airfoil in supersonic flow.

ii. The skin friction drag of an airfoil in supersonic flow.

(b) The power required to generate a thrust of T at a flight speed V by a propeller is 200 kW. Using simple momentum theory, determine the power required to generate the same thrust at the same speed at the same altitude if the diameter of the propeller is increased by 20%. [4+12]

7. For a turbojet propelled high subsonic airplane, it is desired that the maximum rate of coordinated turn at sea level be increased 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

(b) Thereby, 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]

8. (a) What are the flow conditions before and after a normal shock wave? Draw neat sketches.

(b) What do you mean by hypersonic flows? What are the possible physical changes in hypersonic flow, and what are the different characteristics of the flow? Draw neat sketches. [8+8]

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