

## 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) Derive an expression for the maximum angle of steady climb of a turbojet propelled subsonic airplane.  
(b) Discuss the variation of the maximum rate of climb with the wing loading, thrust / weight ratio, the constants of the drag polar, density of the ambient air. [8+8]
2. Explain the terms with neat sketches
  - (a) Normal Shock
  - (b) Oblique shock
  - (c) Expansion waves
  - (d) Mach number (M=0.1 to 5) [4 × 4]
3. Explain the terms with neat sketches:
  - (a) Inertial axes system
  - (b) Body axis system
  - (c) Stability axis system
  - (d) Euler angles. [4 × 4]
4. (a) The power required by a propeller to generate a thrust of T at a flight speed V at an altitude, (where the density ratio is 1), is 900 kW. Using momentum theory, determine the power required to generate the same thrust at a flight speed of 1.6V, at an altitude where the density ratio is 0.7.  
(b) Describe how the trim drag on an airplane may be reduced. [12+4]
5. (a) What is energy height? Derive expressions for specific energy and specific excess power.  
(b) Explain
  - i. ROC (rate of climb) for accelerated flight
  - ii. TOC (time of climb) for accelerated flight [10+6]
6. (a) For an airplane of Gross Weight = 10 tonnes, gross wing area = 33 m<sup>2</sup>, maximum lift coefficient 2.0, maximum permissible normal load factor 3.5, determine the minimum radius of turn. Assuming a drag polar of ( $C_D = 0.008 + 0.04 C_L^2$ ), estimate the power required for sustained level turn at this radius.

- (b) Name the parameters of the aircraft and those of the operating conditions that affect the balanced field length and describe how. [8+8]
7. (a) Describe the effect of sweep on the lift curve slope of a wing of infinite aspect ratio.
- i. in incompressible flow
  - ii. in subsonic compressible flow
  - iii. in supersonic flow
- (b) Name two aspects of airplane performance that are most significantly affected by the chordwise position of the aerodynamic centre of the wing section and describe how. [12+4]
8. (a) Describe the long range ballistic trajectory of missiles. What are the performance parameters to be estimated? Explain the procedure in brief for the following
- i. Powered flight & equation of motion
  - ii. Unpowered flight
- (b) Explain in detail about the tail control and canard control employed for a missile [8+8]

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