B. Tech III Year I Semester Examinations, December-2011
FLIGHT MECHANICS - II
(AERONAUTICAL ENGINEERING)

Time: 3 hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1. Explain about the Purpose of controls – inherently and marginally stable airplanes? Give with neat sketch. [15]

2. A Boeing 737 aircraft has the following characteristics:

   Wmax   =   111, ooo lb
   Wmaxland   =   103,000 lb
   S   =   980 ft²
   CL land   =   2 at sea levels
   V max   =   850 ft/sec at 40,000 ft

   Calculate:

   a) Vs
   b) C_L max
   c) The relation between the lift coefficient and the velocity over the usage speed range at the landing weight at 40,000 feet, if the safe landing speed is taken as1.2$\mathbf{v}_s$. [15]

3.a) What is drag? Explain the types of drag and write drag equation?
  b) Discuss Drag, power, Airspeed Relationship? [8+7]

4. Explain the AIRFOIL types with neat sketches? And discuss about Blade Twist (Rotary – wing Aircraft) [15]

5. Show that Maximum load factor: [15]

$$\overline{V}_{n_m} = \frac{V_{n_m}}{V_{D_{min}}} = \sqrt{\frac{T/S}{\rho C_{D_0}}} \sqrt{\frac{\rho}{2W/S}} \sqrt{\frac{C_{D_0}}{k}} = \sqrt{\frac{T}{W}} E_m$$

6. Write a short note on the following:
   i) Trim tabs   ii) Balance tabs   iii) Balance of forces
   iv) Total aero dynamic forces. [15]

7. Explain briefly on Elevators with neat sketch? And discuss about Tailing – edge flaps? [15]

8. Write about the following terms:
   a) Dutch Roll and Spiral Divergence
   b) Stability Augmenter. [15]

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1.a)   Define stability? Explain the need for stability in airplanes.
  b)   Explain brief on stalling speed and derive it.   [15]

2.   Write a short note on Reciprocating Engine with neat sketch? Prove that: [15]

$$\frac{C_L^{3/2}}{C_D} = \frac{3^{3/4}}{4k^{3/4}C_{D_0}^{1/4}}$$

3.   Discuss about the Power required and Power Available with a neat diagram?
                                                                         [15]

4.   Explain the following terms:
       a) Aerodynamic forces during climbing Flight (with neat diagram)
       b) A symmetrical Thrust and Adverse Yaw .   [7+8]

5.   What are the types of Propellers? And explain them briefly.   [15]

6.   Consider the Aircraft and assume that it has a total power failure at 10,000 feet.
       Its clean drag polar and its maximum lift to drag ratio are follows :
       CD = 0.023 + 0.0735 C²L and **Em** = 12.16.   [15]

7.   Discuss about the Twin Engine Aircraft performance? And explain the Control
       Problems.   [15]

8.a)   Determine the Rate of Climb and climb angle with neat sketch.
  b)   Write about the Aircraft component Contributions.   [7+8]

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1.   Explain about the Aerodynamics of Autorotation in forward Flight? And draw a
      neat sketch.   [15]

2.a) Determine the Need for stability in an Airplane?
  b) Determine the range of the following propeller driven aircraft, with the following
      data, at a constant airspeed of 180 mph at 8,000 ft altitude:
            W1   =   18,500 lb
            Wfuel   =   6,000 lb
            S   =   939 ft²
            $\eta_p = 0.85$
            C   =   0.45 Lb/HP-hr
            CD   =   0.0192 + 0.047C²**L** .   [15]

3.   Draw a neat sketch about Maneuvering diagram? And explain it briefly?   [15]

4.   Explain about the Balance of forces with a neat sketch? And differentiate between
      the induced flow and vertex generation?   [15]

5.   Write a short note on the following :
      a) Flying Techniques   and
      b) Wind Shear Recovery Techniques.   [15]

6.   Discuss about the   Angle of Attack and also explain the Effects of Airflow?
                                                                          [15]
7.a) Determine the Breguet Cruise – Climbing Flight.
  b) Range integration Method   [7+8]

8.   Write a short note on Dutch Roll?   And differentiate between Directional
      Divergence and spiral Divergence.   [15]
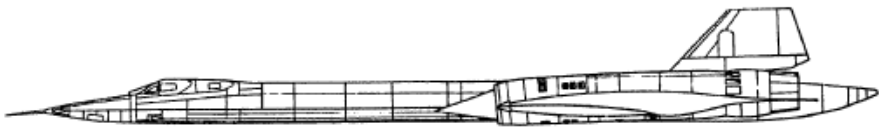

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1.a) Write the following abbreviations below :
     I.   BCM
     II.   AOA
     III.   AMPS
     IV.   ADSS
     V.   AFM
     VI.   AHO
     VII.   ATM
     VIII.   AIM

   b) An aircraft a wing area of 255 ft² and a clean drag polar (flaps and gear up) of
CD =0.023 + 0.0735**CL**, **AR** =5.07 Calculate:
a) (**L/D**)lmax
b) **V**Dmin at sea level and at 40,000 ft
c) **T**min for level flight.   [7+8]

2. Explain about the Flight Envelope: **V**max, **V**min   [15]

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3. Discuss about the Turning Flight in Horizontal Flight with neat sketch?   [15]

4. Explain the following terms:
i) Spiral Flight with a neat sketch
ii) Brief on Dutch Roll.   [15]

5.a) Write a short note about the " Powered Boosted"
   b) Explain about the "Single Engine Operation"?   [7+8]

6. Determine the Engine Yawing Thrust with a neat Diagram.   [15]

7. Write about the Velocity at minimum Control Certification with some
configuration?   [15]

8.a) Draw neat sketches about sideslip.
   b) Write a short note on Drag Reduction   [7+8]

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