Code No: 07A62101 **R07** **Set No. 2**

III B.Tech II Semester Examinations,APRIL 2011
FLIGHT MECHANICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. The aerodynamic forces and moments on the body are due to only two basic sources as given below. Explain them with sketches
   (a) Pressure distribution over the body surface
   (b) Shear stress distribution over the body surface. [8+8]
2. With the help of sketches, explain the method of measurement of coupled aerodynamic stability and damping derivatives in a wind tunnel. [16]
3. What are the two necessary criteria for longitudinal balance and static stability? Explain with neat sketches. [16]
4. Calculate and plot curves of an airplane angular velocity in radians per second versus true air speed in km per hour for the following airplane normal accelerations obtained in pull-up maneuver from level flight: n = 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 8.0. The speeds range from 150 kmph to 600 kmph. Compute for 8 speeds. [16]
5. Define floating tendency and restoring tendency in the case of stick-free longitudinal stability and derive an expression for control surface angle. [16]
6. Describe the need for controls in airplane associated with the static and dynamic stabilities of an airplane. [16]
7. Show with two examples, that the lateral and directional dynamics of airplane are strongly coupled. Explain from the characteristic equation of lateral - directional dynamics, the types of oscillations of the airplane. [16]
8. Bring out the relationship between yaw and roll of an airplane in the following cases:
   (a) Rolling moment with yaw rate
   (b) Yawing moment with roll rate. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A62101 **R07** **Set No. 4**

III B.Tech II Semester Examinations,APRIL 2011
FLIGHT MECHANICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) With a neat sketch show the anes system associated with an air plane.
   (b) Explain how the forces and moments acting on the airplane are controlled. [8+8]

2. Derive an expression for stick fixed neutral point of an airplane. [16]

3. (a) Explain with appropriate sketches, the following:
      i. Phugoid motion
      ii. Spiral instability
      iii. Dutch Roll motion.
   (b) What is the significance of the derivative $C_{l\beta}$ arising from the dihedral of the wing Γ, of an aircraft in terms of the lateral stability of the aircraft? Explain briefly. [8+8]

4. Define the term stick fixed neutral point N_0 and stick fixed maneuver point N_m in a pull-up maneuver of an airplane. Derive an expression for N_m in terms of N_0, W/S etc. Explain all terms. [16]

5. (a) How are the terms static stability and dynamic stability associated with an airplane? Explain with at least one example for static stablity and two examples for dynamic stability. Use sketchs.
   (b) Is stability a part of the airplane design and operation? Does the pilot apply control in this respect? Please illustrate. [8+8]

6. Discuss qualitatively, various ways of improving the lateral and directional stability of an aircraft. [16]

7. Develop the equation of motion for an airplane that has freedom only along the flight path; that is, variation in forward speed. If the airplane is perturbed from its equilibrium state what type of motion would you expect? Clearly state all of your assumptions. [16]

8. Derive the expression for the stick free neutral point in the case of an elevator of an airplane. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A62101 **R07** **Set No. 1**

III B.Tech II Semester Examinations,APRIL 2011
FLIGHT MECHANICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Explain the following terms
   (a) Down wash
   (b) Induced angle of attack
   (c) Effective angle of attack. [4+6+6]

2. (a) Derive an expression for the normal load factor of an airplane in a steady constant speed, constant angular rate pull - up maneuver in a vertical loop when the airplane is at a flight path angle γ in the loop.
   (b) An airplane of mass 1.5 tonnes, flying at 250 kmph pulls up in a vertical circular loop of radius 1.2 km. What is the lift required for this maneuver of the airplane while at a flight path angle $\gamma = 60$ degrees to the horizontal? [8+8]

3. Explain the aerodynamic forces on a stabilator configuration in stick free condition of an airplane. [16]

4. When the aircraft is not perturbed about the roll or yaw axis, only the longitudinal modes are required to describe the motion. These modes are usually divided into two distinct types of motion. What are they? Explain in detail. [16]

5. Explain the phenomenon of Dutch roll, using all the aerodynamic coefficients and aircraft parameters influencing the motion. [16]

6. (a) The use of stability derivatives is most conveniently demonstrated with missile or rocket configurations. Why? Give the explanation.
   (b) Show that $d\beta / dt = (Y_\beta / m U)\ \beta - r$
   $dr/dt = (N_\beta / C)\ \beta + (N_r / C)\ r$ [8+8]

7. Aircraft flight controls fall into two broad categories. What are those categories? Explain them in detail with figures. [16]

8. Derive the expression for the pedal force for the rudder of an airplane as a function of hinge moment coefficients. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A62101 **R07** **Set No. 3**

III B.Tech II Semester Examinations,APRIL 2011
FLIGHT MECHANICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Explain the causes and describe the significance of the stability derivatives $C_{y,\beta}$, $C_{n,\beta}$ $C_{l,\beta}$, $C_{l,p}$ and $C_{n,\delta r}$. Use sketches. [16]

2. (a) Explain the following terms with examples
   i. Stability
   ii. Equilibrium.
   (b) Comment upon the requirements of stability of a
   i. Military fighter aircraft
   ii. Commercial passenger airplane. [4+4+4+4]

3. Explain in detail about the elevator control power with sketches. Derive the equation $\left(\frac{dC_m}{dC_L}\right)_{Tail} = -a_t \overline{V} \eta_t$ [16]

4. Derive an expression for the elevator angle required to overcome the rotational moment of an aircraft about its pitch axis in terms of the forward velocity and load factor of the airplane 'n' for pull up from level flight, assuming 10 % increase in tail damping requirement. [16]

5. Derive an expression for the floating angle of the elevator of an airplane at a given tail angle of attack α_t and air speed V, in terms of the aerodynamic, geometric and inertial properties of the elevator. [16]

6. What are the two distinct types of longitudinal modes, required to describe the motion of an aircraft, when the aircraft is not perturbed about the roll or yaw axis? Explain them in detail. [16]

7. The flight of a stable projectile, such as an arrow or a stable bomb, can be approximated as pure longitudinal motion. If the projectile is stable enough, the angle of attack remains small and we can approximate the longitudinal aerodynamic forces and moments. Explain the forces and moments in this case. [16]

8. Derive the expression for the derivative of pedal force for the rudder of an airplane with yaw angle of the airplane. [16]

⋆ ⋆ ⋆ ⋆ ⋆