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

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
Flight Mechanics-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Using proper sketches, explain stick free longitudinal stability of an airplane. [16]
2. Explain pure convergence and pure divergence and damped and negatively damped oscillations in the case of an airplane. [16]
3. (a) Explain various types of ailerons and compare the corresponding hinge moments through sketches.
   (b) Explain various types of elevator tabs and compare the corresponding hinge moments through sketches. [8+8]
4. (a) Describe briefly about the spoilers and speed brakes.
   (b) And their use in aircraft. [8+8]
5. (a) Three dynamic modes describe the lateral motion of an aircraft. What are they? Explain in detail.
   (b) Explain the orientation and position of an airplane in terms of a fixed frame of reference. Illustrate with sketch. [8+8]
6. Derive an expression for stick force in a stick free longitudinal stability of an aircraft. Also explain the term elevator gearing. [16]
7. Establish that $(dC_m/dC_L)_{fixed}$ is the criterion of static longitudinal stability of airplane. Hence develop an expression for the same for an airplane with conventional wing tail combination. Include the effect of power plant in the expression. Explain the contribution of each part of the airplane. [16]
8. Derive an expression for the derivative of the stick force with load factor for a turn flight in terms of $C_{H\delta,e}$, $C_{H\alpha}$, $(dC_m/dC_L)_{Free}$, etc. Explain all the terms in the expression. [16]

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

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
Flight Mechanics-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the effect of centre of gravity location on the stability of an aircraft.
   (b) Estimate the side wash gradient for the vertical tail using vortex model method. [8+8]

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

3. 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]

4. What are the two broad categories of aircraft flight controls fall? Explain them in detail with figures. [16]

5. Describe the need for controls in airplane associated with the static and dynamic stabilities of an airplane. [16]

6. Draw typical variation of (d δ_e / d n) versus centre of gravity position as a per cent of mean aerodynamic chord. Explain the variations. [16]

7. 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]

8. The characteristic equation of dynamic longitudinal stability of an airplane is
   $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$,
   where A = 1.0, B = 13.4, C = 67.4, D = 394, E = - 73.8.
   Find the short period and phugoid period of oscillations.
   Assume any other data necessary for the computation, but not given here, with necessary explanations. [16]

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

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
Flight Mechanics-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the two necessary criteria for longitudinal balance and static stability? Explain with neat sketches. [16]
2. With the help of sketches, explain the method of measurement of coupled aerodynamic stability and damping derivatives in a wind tunnel. [16]
3. Prove using sketches and plots that the wing sweep back (+ Λ) produces positive dihedral effect, i.e., (negative $C_{l\beta}$) [16]
4. Roll accompanies yaw and yaw accompanies roll - elaborate the statement with sketches. [16]
5. (a) Explain using an appropriate sketch, the relative positions of centre of gravity of an airplane and the stick fixed and stick free neutral points.
   (b) Explain the requirement of c.g. limits of an aircraft for the two cases referred to above. [16]
6. Write the characteristic equations for a pure yawing motion. Explain the terms involved. [16]
7. Define and explain the stick - free maneuver point N'_m in terms of in terms of N'_0 and the derivatives $C_{H\alpha}$ and $C_{h,\delta}$. Explain all the terms involved. [16]
8. A rocket is flying at an airspeed of 300 m/s. The angle of attack is 30 degrees and the sideslip angle, β_e, is 20 degrees, with bank angle of 40 degrees and elevation angle of 20 degrees and an azimuth angle of 70 degrees. Assuming no wind, what is its velocity in earth - fixed coordinates? [16]

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

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
Flight Mechanics-II
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 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]

2. Write a typical Transfer Function for an aircraft and explain. How is it useful in explaining the behaviour of the aircraft for a disturbance? [16]

3. Explain the aerodynamic forces on elevator - stabilizer configuration in the stick free condition of an airplane. [16]

4. The location of the wing on the longitudinal axis of the fuselage is of considerable importance to its destabilizing influence. Multhopp proposed a formula to account for this phenomenon. What is that formula? Derive it with the support of sketches. [16]

5. Starting with the Z force equation, use the small - disturbance theory to determine the linearized force equation. Assume a steady - level flight for the reference flight conditions? [16]

6. (a) Compare the connentional airplane configuration with a canasol-wing-tail combination. Make use of suitable figures.
   (b) Differentiate between swept-back and forward wing configurations. [8+8]

7. If the rudder angle δ_r required to produce the sideslip angle ψ is given by $\delta_r = (\mathrm{d}\ \delta_r\ /\ \mathrm{d}\ \psi\ )\psi$, derive the following equation for the expression for the rate of change of pedal force with the side slip angle,
   $\mathrm{d\ PF}\ /\ \mathrm{d}\ \psi = [\ \{ -\ \mathrm{G\ q\ S_r\ c_r}\ \eta_v\ \mathrm{C}_{\mathrm{h},\ \delta r}\ \}\ /\ \mathrm{C}_{\mathrm{n},\ \delta r}\ ]\ (\mathrm{C}_{\mathrm{n},\ \psi}\ )_{\mathrm{Free}}$ [16]

8. Explain in detail, with sketches, the functioning of the
   (a) Trim tabs
   (b) Servo tabs
   (c) Balance tabs
   (d) Spring tabs . [4+4+4+4]

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