Code No: R32211/R10 **Set No. 1**

III B.Tech II Semester Regular/Supple. Examinations, April 2017
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. (a) Show with a sketch the axes system associated with an airplane. [8+7]
   (b) Explain the equilibrium forces and moments acting on the airplane, illustrating with sketches and plots. How are these forces and moments controlled?

2. Starting with the Y force equation (side force equation), use the small - disturbance theory to determine the linearized force equation. Assume a steady - level flight for the reference flight conditions. [15]

3. Show that the stability derivative $C_{l,\beta} = \frac{2\Gamma}{57.3}\frac{dC_L}{d\beta}\frac{\overline{y}}{b}\frac{S_T}{S}$ holds for an airplane with dihedral when a right side slip produces left rolling moments (with standard notations) [15]

4. (a) Write about the control fixed static stability.
   (b) Explain elevator angle to trim. Also explain about the stability margins with figures. [8+7]

5. Explain the aerodynamic forces on a stabilator configuration in stick free condition of an airplane. [15]

6. Calculate and show in a tabular form, the airplane angular velocities (pitch rate) in radians per second versus true air speed in kmph for the following airplane normal accelerations obtained in steady systematic pull-ups from level flight:
   n = 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 8.0.
   The speeds should range from 150 kmph to 650 kmph. [15]

7. An airplane is making a steady turn at constant altitude at an angle of bank of 60 degrees. If the speed of the aircraft is 300 kmph and the acceleration is 2g, what is the pitch rate of the airplane in degrees per second required for this maneuver? [15]

8. A fighter type airplane has aerodynamic, geometric, mass, and inertia characteristics given below. If this airplane is placed in a glide at 3000 m altitude with power-off at $C_L = 1.0$, calculate the stability derivatives $C_{L\alpha}$, $C_{D\alpha}$, $C_{m\alpha}$, $C_{md\alpha}$ and $C_{md\theta}$. [15]

   Moment of Inertia about Y axis = 20,000 kgm^2. Horizontal tail span = 4 m
   Mass of the airplane = 4,500 kg Stick-fixed neutral point ($T_c = 0$) = 0.38 c
   Wing area = 25 sq. m. Centre of gravity location = 0.33 c

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Wing span = 12 m	Rate of change of downwash, $d\varepsilon / d\alpha = 0.5$
Mean aerodynamic chord = 2.5 m	$a_0 = 0.10$
Taper ratio = 2 : 1	$\eta_t = 0.90$
Horizontal tail area = 5.0 sq. m.	e = 0.85
Distance from c.g. to tail = 6.1 m	$C_{Df} = 0.02$

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