Code No: R05312102 **R05** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
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) Explain the principle of airplane propulsion which takes care of all such devices in a uniform manner.

   (b) Hence explain the mechanism / underlying theory which describes the generation of required force from a propeller. Draw sketches and plots to elaborate your answer. [8+8]

2. (a) Describe the airfoil section geometry represented by NACA 23012. Plot the lift curve and explain laminar flow and separation of flow over this section. Make use of sketches and plots.

   (b) Describe the formation of vortex system over an airfoil placed in an air stream at low angle of attack . [8+8]

3. (a) Describe a rocket and a missile. What are the uses of each of the two? Explain the geometry and different parts with neatly drawn sketches.

   (b) Classify chemical rockets in as many ways as you may like. Describe each category with sketches and for its uses. [8+8]

4. A light airplane weighing 9000 N and with a wing area of 12.7 m^2, has a maximum lift coefficient of 1.5 and its drag polar is given by $C_D = 0.020 + 0.050C_L^2$. It is powered by a single turbo-jet engine providing a thrust of 1350 N at all speeds at sea level. Estimate the minimum time to turn through 180^0 at sea level, the corresponding load factor and the lift. [16]

5. Consider the Earth to be flat and non rotating for simple analysis of flight trajectories of airplanes. Show that the general dynamical equations reduce to the form: $T + A + mg = ma = m\frac{dv}{dt}$,

   Where T, A, m, g and a are thrust, aerodynamic force, mass, acceleration due to gravity and the acceleration of the airplane w.r.t the Earth. [16]

6. A rigid body having a reference frame $Oxyz$ moves with respect to a fixed reference frame $\Omega\xi\eta\zeta$. Show that the distribution of velocities at a point P within the rigid body is given by the expression $V = V_o + \omega \times OP$ Hence obtain the distribution of accelerations within the rigid body given $a = a_o + \omega \times (\omega \times OP) + \dot{\omega} \times OP$. [16]

7. (a) Define the adiabatic process. Making use of the same, obtain pressure, density and temperature ratios along a stream line under stagnation conditions. The velocity may be put in terms of Mach number.

(b) Define the Mach number range for subsonic, transonic, supersonic and hypersonic velocities. [10+6]

8. An airplane has a wing area of 100 m^2 and drag equation $C_D = 0.014 + 0.038\ C_L^2$. At the start of cruise, it weighs 265,000 N, of which 20% is fuel. It is estimated that at the end of cruise, 13,500 N of fuel must remain in the tanks. Estimate the maximum cruise distance in kilometers, and the altitudes at the start and end of the cruise. Take the engine thrust at 11,000 m to be 14700 N and as proportional to the relative density in the stratosphere. Further, if 22,000 N of fuel is used before start of the cruise, estimate the gross still air range. The specific fuel consumption be taken as 0.85 kg/N-hr. [16]

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Code No: R05312102 **R05** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
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) Describe a rocket and a missile. What are the uses of each of the two? Explain the geometry and different parts with neatly drawn sketches.

   (b) Classify chemical rockets in as many ways as you may like. Describe each category with sketches and for its uses. [8+8]

2. A light airplane weighing 9000 N and with a wing area of 12.7 m^2, has a maximum lift coefficient of 1.5 and its drag polar is given by $C_D = 0.020 + 0.050C_L^2$. It is powered by a single turbo-jet engine providing a thrust of 1350 N at all speeds at sea level. Estimate the minimum time to turn through 180^0 at sea level, the corresponding load factor and the lift. [16]

3. A rigid body having a reference frame $Oxyz$ moves with respect to a fixed reference frame $\Omega\xi\eta\zeta$. Show that the distribution of velocities at a point P within the rigid body is given by the expression $V = V_o + \omega \times OP$ Hence obtain the distribution of accelerations within the rigid body given $a = a_o + \omega \times (\omega \times OP) + \dot{\omega} \times OP$. [16]

4. (a) Describe the airfoil section geometry represented by NACA 23012. Plot the lift curve and explain laminar flow and separation of flow over this section. Make use of sketches and plots.

   (b) Describe the formation of vortex system over an airfoil placed in an air stream at low angle of attack . [8+8]

5. (a) Explain the principle of airplane propulsion which takes care of all such devices in a uniform manner.

   (b) Hence explain the mechanism / underlying theory which describes the generation of required force from a propeller. Draw sketches and plots to elaborate your answer. [8+8]

6. (a) Define the adiabatic process. Making use of the same, obtain pressure, density and temperature ratios along a stream line under stagnation conditions. The velocity may be put in terms of Mach number.

   (b) Define the Mach number range for subsonic, transonic, supersonic and hypersonic velocities. [10+6]

7. An airplane has a wing area of 100 m^2 and drag equation $C_D = 0.014 + 0.038\ C_L^2$. At the start of cruise, it weighs 265,000 N, of which 20% is fuel. It is estimated that at the end of cruise, 13,500 N of fuel must remain in the tanks. Estimate the maximum cruise distance in kilometers, and the altitudes at the start and end of

the cruise. Take the engine thrust at 11,000 m to be 14700 N and as proportional to the relative density in the stratosphere. Further, if 22,000 N of fuel is used before start of the cruise, estimate the gross still air range. The specific fuel consumption be taken as 0.85 kg/N-hr. [16]

8. Consider the Earth to be flat and non rotating for simple analysis of flight trajectories of airplanes. Show that the general dynamical equations reduce to the form: $T + A + mg = ma = m\frac{dv}{dt}$,

   Where T, A, m, g and a are thrust, aerodynamic force, mass, acceleration due to gravity and the acceleration of the airplane w.r.t the Earth. [16]

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Code No: R05312102 **R05** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
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 light airplane weighing 9000 N and with a wing area of 12.7 m^2, has a maximum lift coefficient of 1.5 and its drag polar is given by $C_D = 0.020 + 0.050C_L^2$. It is powered by a single turbo-jet engine providing a thrust of 1350 N at all speeds at sea level. Estimate the minimum time to turn through 180^0 at sea level, the corresponding load factor and the lift. [16]

2. (a) Explain the principle of airplane propulsion which takes care of all such devices in a uniform manner.
   (b) Hence explain the mechanism / underlying theory which describes the generation of required force from a propeller. Draw sketches and plots to elaborate your answer. [8+8]

3. A rigid body having a reference frame $Oxyz$ moves with respect to a fixed reference frame $\Omega\xi\eta\zeta$. Show that the distribution of velocities at a point P within the rigid body is given by the expression $V = V_o + \omega \times OP$ Hence obtain the distribution of accelerations within the rigid body given $a = a_o + \omega \times (\omega \times OP) + \dot{\omega} \times OP$. [16]

4. Consider the Earth to be flat and non rotating for simple analysis of flight trajectories of airplanes. Show that the general dynamical equations reduce to the form: $T + A + mg = ma = m\frac{dv}{dt}$,

   Where T, A, m, g and a are thrust, aerodynamic force, mass, acceleration due to gravity and the acceleration of the airplane w.r.t the Earth. [16]

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   (b) Describe the formation of vortex system over an airfoil placed in an air stream at low angle of attack . [8+8]

6. (a) Define the adiabatic process. Making use of the same, obtain pressure, density and temperature ratios along a stream line under stagnation conditions. The velocity may be put in terms of Mach number.
   (b) Define the Mach number range for subsonic, transonic, supersonic and hypersonic velocities. [10+6]

7. (a) Describe a rocket and a missile. What are the uses of each of the two? Explain the geometry and different parts with neatly drawn sketches.

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Code No: R05312102 **R05** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
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) Describe the airfoil section geometry represented by NACA 23012. Plot the lift curve and explain laminar flow and separation of flow over this section. Make use of sketches and plots.

   (b) Describe the formation of vortex system over an airfoil placed in an air stream at low angle of attack . [8+8]

2. Consider the Earth to be flat and non rotating for simple analysis of flight trajectories of airplanes. Show that the general dynamical equations reduce to the form: $T + A + mg = ma = m\frac{dv}{dt}$,

   Where T, A, m, g and a are thrust, aerodynamic force, mass, acceleration due to gravity and the acceleration of the airplane w.r.t the Earth. [16]

3. (a) Define the adiabatic process. Making use of the same, obtain pressure, density and temperature ratios along a stream line under stagnation conditions. The velocity may be put in terms of Mach number.

   (b) Define the Mach number range for subsonic, transonic, supersonic and hypersonic velocities. [10+6]

4. (a) Explain the principle of airplane propulsion which takes care of all such devices in a uniform manner.

   (b) Hence explain the mechanism / underlying theory which describes the generation of required force from a propeller. Draw sketches and plots to elaborate your answer. [8+8]

5. A rigid body having a reference frame $Oxyz$ moves with respect to a fixed reference frame $\Omega\xi\eta\zeta$. Show that the distribution of velocities at a point P within the rigid body is given by the expression $V = V_o + \omega \times OP$ Hence obtain the distribution of accelerations within the rigid body given $a = a_o + \omega \times (\omega \times OP) + \dot{\omega} \times OP$. [16]

6. (a) Describe a rocket and a missile. What are the uses of each of the two? Explain the geometry and different parts with neatly drawn sketches.

   (b) Classify chemical rockets in as many ways as you may like. Describe each category with sketches and for its uses. [8+8]

7. An airplane has a wing area of 100 m^2 and drag equation $C_D = 0.014 + 0.038\ C_L^2$. At the start of cruise, it weighs 265,000 N, of which 20% is fuel. It is estimated that at the end of cruise, 13,500 N of fuel must remain in the tanks. Estimate the maximum cruise distance in kilometers, and the altitudes at the start and end of

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