Code No: 09A52101 R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November/December - 2012
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 the means of control and the task of the pilot to ensure controlled flight conditions meeting a pre-defined aircraft mission profile. [15]

2.a) Discuss in detail the motion of an aircraft in steady, symmetric pull-up maneuvers and coordinated turns.
b) Explain pitch damping, control to trim, maneuver margin and their relation to static margin. [8+7]

3. Consider an aircraft taking a turn in flight. Discuss the following associated with this condition:
a) Aerodynamic forces and moments acting on the aircraft due to roll and yaw.
b) Rolling moment and yawing moment acting on the aircraft due to side slip
c) Side forces on the aircraft. [15]

4.a) What are the relationships that exist between dimensionless and dimensional aerodynamic derivatives?
b) Obtain the expressions for derivatives of side force and rolling and yawing moments with respect to the angle of side slip, roll rate and rudder deflection respectively. [5+10]

5. Write short notes on the following associated with description of motion of a flight vehicle:
a) Reference frame systems – earth fixed, body fixed, wind and stability axes
b) Earth fixed-to-body axes transformation. [7+8]

6.a) Discuss about the assumptions made in obtaining equations of motion of an aircraft in terms of perturbation variables.
b) Explain decoupling of equations of motion of the aircraft by mentioning the conditions for its validity. [8+7]

7. Discuss the dynamic stability aspects of an aircraft considering its linearized longitudinal equations of motion being analyzed under three degrees-, two degrees-, and one degree- of freedom assumptions. [15]

8. Write short notes on the following aspects related to aircraft dynamics:
a) Roll-Yaw coupling
b) Aircraft spin and recovery
c) Wing rock. [15]

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Code No: 07A62101	R07	SET-1

B. Tech III Year II Semester Examinations, December-January, 2011-2012
FLIGHT MECHANICS - II
(AERONAUTICAL ENGINEERING)

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

Answer any five questions
All questions carry equal marks

1.a) Explain the degrees of freedom of a rigid body.
b) Explain the purpose of controls of an aircraft. [8+8]

2. Write the equations of motion of a rigid body with six degrees of freedom. Explain how they reduce in the case of an aircraft with a plane of symmetry flying with elevator, aileron and rudder deflected. [16]

3.a) Explain the difference between aerodynamic coefficients and aerodynamic derivatives. Give four pairs of examples with explanation.
b) Illustrate the control derivatives. [10+6]

4. Describe the forces and moments acting on an aircraft (in flight) in the plane of symmetry, with the help of a neat diagram. Using these, find an expression for the slope of the curve of C_m vs C_L [i.e., (dC_m / dC_L)] of the aircraft (C_m being the coefficient of moment acting on the aircraft about its centre of gravity) in terms of the contributions of the wing, fuselage and horizontal stabilizer. [16]

5. Describe aerodynamic balancing of an elevator. [16]

6. Derive an expression for the slope of the stick force versus speed curve in pull-up manoeuvre of an aircraft. [16]

7. Write short notes on
a) Contribution of ailerons for Roll moment of an aircraft
b) Rudder power
c) Mechanical gearing
d) Rudder lock. [16]

8. State the perturbed equations of motion of an aircraft, where perturbation is from the state of steady level flight. Explain how the stability of an aircraft is analyzed using these equations. [16]

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Code No: 07A62101	R07	SET-2

B. Tech III Year II Semester Examinations, December-January, 2011-2012
FLIGHT MECHANICS - II
(AERONAUTICAL ENGINEERING)

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

Answer any five questions
All questions carry equal marks

1.a) Explain static and dynamic stabilities in general.
b) Explain static and dynamic stabilities of an aircraft. [8+8]

2. Derive the equations of motion of a rigid body with six degrees of freedom. [16]

3. Describe the derivatives of yawing moment of an aircraft with respect to angle of sideslip, rate of side slip, roll rate and yaw rate. [16]

4. Define longitudinal static stability of an aircraft. Derive an expression for stick fixed neutral point. [16]

5. Define hinge moments of aerodynamic surfaces. Derive an expression for the floating angle of an elevator. [16]

6. Derive an expression for the load factor of an aircraft in a coordinated turn in a horizontal plane. [16]

7. Write short notes on
a) Static directional stability
b) Contribution of fuselage to directional stability
c) Adverse yaw. [5+6+5]

8.a) Explain how dynamic stability of an aircraft is established with the help of Routh's Criteria.
b) Describe Dutch roll and spiral instability. [8+8]

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Code No: 07A62101	R07	SET-3

B. Tech III Year II Semester Examinations, December-January, 2011-2012
FLIGHT MECHANICS - II
(AERONAUTICAL ENGINEERING)

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

Answer any five questions
All questions carry equal marks

1.a) Explain the controls of an aircraft and their effect on the motion of the aircraft.
b) What is the difference in the responses of marginally stable aircraft and unstable aircraft to disturbances? [8+8]

2. Write the equations of motion of an aircraft which has the plane passing through the longitudinal axis and the yaw axis as the plane of symmetry. With the help of these, explain how the longitudinal and lateral-directional motions of the aircraft are coupled. [16]

3. Define three aerodynamic coefficients and their non-dimensional derivatives due to velocity, angle of attack rate and pitch rate. [16]

4. Write the equations of equilibrium of an aircraft in an unaccelerated flight including the contribution of elevator angle required to trim. [16]

5. Write short notes on
a) Trim tabs
b) Free elevator
c) Aerodynamic distribution over a horizontal stabilizer with and without elevator deflection. [16]

6. Derive an expression for the elevator angle required to bring an airplane into equilibrium in terms of the lift coefficient, elevator power and derivative of pitching moment w.r.t. lift coefficient. [16]

7. Explain the contributions of vertical tail, wing dihedral and position of wing on fuselage to lateral stability of an aircraft. [16]

8. Describe phugoid, short period and spiral modes of flight. [16]

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Code No: 07A62101	R07	SET-4

B. Tech III Year II Semester Examinations, December-January, 2011-2012
FLIGHT MECHANICS - II
(AERONAUTICAL ENGINEERING)

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

Answer any five questions
All questions carry equal marks

1.a) Explain the degrees of freedom of an aircraft.
b) Explain the response of an unstable aircraft to disturbance. How does such an aircraft fly? [8+8]

2. Write down the lateral-directional equations of motion of an aircraft and identify (describe) each term of the equation. [16]

3.a) Describe the strip theory method, with relevant equations, to estimate the pitching moment of the fuselage of an aircraft.
b) Derive the expression for the pitching moment of an aircraft as a function of the elevator angle. [8+8]

4. Explain the effects of angle of attack of the aircraft, wing setting and the other relevant parameters on the lift and moment created by the horizontal stabilizer. Using these, derive an expression for the tail contribution to stability of the aircraft, (dC_m / dC_L) of tail surface. [16]

5. Derive an expression for the location of the neutral point in the case of stick free longitudinal motion of an aircraft. [16]

6. An aircraft traveling at 150 m/s speed is put into a coordinated turn in a horizontal plane. If the aircraft should not cross a load factor of 5, what is the maximum angular velocity of the aircraft about the local vertical axis? [16]

7. Derive the expression for the slope of the pedal force versus sideslip curve in stick free motion of an aircraft. [16]

8. Explain how the stability quartic helps in studying the dynamic stability of an aircraft. [16]

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