

## AIRCRAFT STABILITY AND CONTROL

<b>V Semester</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
A5AE19	PCC	L	T	P	C	CIE	SEE	Total
		3	0	0	3	30	70	100
<b>COURSE OBJECTIVES:</b>								
Students should be able to:								
At the end of the course the students are able to:								
<ol style="list-style-type: none"> <li>1. Describe the contribution of various airplane components to the static longitudinal stability.</li> <li>2. Distinguish between stick fixed and stick free stability longitudinal static stability of an airplane conditions</li> <li>3. Formulate the rigid body equations of motions of an airplane</li> <li>4. Estimate the longitudinal and lateral stability derivatives of an airplane</li> <li>5. Assess different modes of dynamic aspects of an airplane</li> </ol>								
<b>UNIT-I</b>	<b>STATIC LONGITUDINAL STABILITY AND CONTROL</b>							
Introduction Static and dynamic stability-Need for controlled flight - Equilibrium, stability, control, trim-definitions- examples-Need for stability in airplanes. Purpose and types of controls. Static longitudinal stick fixed stability-Stability criterion, Contribution of wing-tail and elevator to pitching moments. Effect of fuselage and nacelles, Effects of center of gravity location, Power effects- Stabilizer setting and center of gravity location, Elevator power, Elevator to trim. Stick fixed neutral point								
<b>UNIT-II</b>	<b>STATIC LONGITUDINAL STABILITY - CONTROL FREE AND MANEUVER STABILITY</b>							
Static longitudinal stability stick free-Effects of releasing the elevator. Hinge moment coefficients, Control forces to trim. Control free neutral point - Trim tabs. Aerodynamic balancing of control surfaces. Control deflections and control forces for trim in symmetric manoeuvres and coordinated turns. Control deflection and force gradients. Control fixed and control free manoeuvre stability- Manoeuvre points. Manoeuvre margins								
<b>UNIT-III</b>	<b>INTRODUCTION- EQUATIONS OF MOTION</b>							
Airplane coordinate system-Degree of freedom of a system-Equations of motion of a rigid body-position and orientation of airplane-Inertial forces and moments-gravitational and thrust forces-small disturbance theory-linearization of equations of motion-aerodynamic forces and moment representation								
<b>UNIT-IV</b>	<b>AERODYNAMIC STABILITY DERIVATIVES</b>							
Aerodynamic stability and control derivatives-derivative due to change in forward speed-derivatives due to pitching velocity <sup>2</sup> derivatives due to time change of angle of attack-lateral stability derivatives- Derivatives of side force, rolling and yawing moments with respect to the angle of sideslip, rate of sideslip								
<b>UNIT-V</b>	<b>STATIC LATERAL AND DIRECTIONAL STABILITY AND CONTROL,DYNAMIC</b>							
Lateral and directional stability- definition-Dihedral effect, Coupling between rolling and yawing moment, Adverse yaw, Aileron power, Aileron reversal. Weather cocking effects, Rudder power. Control surface deflections in steady sideslips, rolls and turns one engine inoperative conditions, Rudder lock-Solutions to the linearized equations of motion. The principal modes. Phugoid, Short Period Dutch Roll and Spiral modes, Further approximations. Restricted degrees of motion. Solutions. Response to controls. Auto rotation and spin recovery, pilot techniques.								
<b>Text Books:</b>								

1. Perkins C. D, Robert Hage E (2003), Airplane Performance, Stability and Control, Wiley Toppan, USA.
2. Nelson R. C (2007), Flight Stability and Automatic Control, SIE edition, McGraw Hill, New York.

**Reference Books:**

1. T. R. Yechout, S. L. Morns (2003), Introduction to Aircraft Flight Mechanics, AIAA Publishers, USA
2. Mc. Cormic B. W. (2010), Aerodynamics, Aeronautics and Flight Mechanics, Wiley India Pvt. Ltd, USA

**COURSE OUTCOMES:**

The purpose of this subject is to provide the students with the theoretical background and engineering applications.

1. Describe the contribution of various components to the static longitudinal stability of the aircraft
2. Evaluate the effect of centre of gravity on the static longitudinal stability of the aircraft
3. Ability to distinguish between stick fixed and stick free stability conditions
4. Discuss the aerodynamic stability and control derivatives of the aircraft
5. Explain the longitudinal and lateral motions of the aircraft