Flight Dynamics II (Stability) - Video course

COURSE OUTLINE

Airplane nomenclature and aerodynamics, Review of basics of rigid body dynamics, Concepts of static and dynamic stability, Need for stability in an airplane, Purpose of controls, Inherently and marginally stable airplanes,Longitudinal and Lateral directional static stability.

Stick Fixed: Basic equations of equilibrium, Stability criterion, Wing and tail moments, Effects of fuselage and nacelles.

Effects of c.g.location, control effectiveness, hinge moment, tabs, aerodynamic balancing, Power effects.

Stabiliser setting and c.g.location, Elevator effects, Stick fixed neutral point, Determination of neutral points and maneuver points in flight tests.

Stick Free: Hinge moment coefficients, Stick free neutral point,symmetric maneuvers, Stick force gradients and stick force per g.

Dihedral effect, Coupling between rolling moment and yawing moment, Adverse yaw, Aileron power. Aileron reversal. Weathercock effect, Rudder requirements. One engine inoperative conditions, Rudder lock.

Equations of motion, equations of motion of a disturbed aircraft, aircraft dynamic modes and stability criterion,Stability derivatives, Control derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

Dutch roll and spiral instability. Longitudinal & lateral directional dynamic modes. Effect of maneuvers, Airplane response to atmospheric and control inputs,Introduction to flying qualities and stability augmentation Systems. Aircraft autopilot design using classical control theory. Introduction to nonlinear problems in aircraft flight dynamics.

COURSE DETAIL

A video course shall consist of 40 or more lectures with 1 hour duration per lecture.

Topics	No.of Hours
LM1: Review of rigid body dynamics.	2
LM2: Review of stability concepts.	2
LM3: Aircraft nomenclature, aerodynamics, aircraft axes systems.	3
LM4: Longitudinal static stability of aircraft.	6
LM5: Lateral directional static stability of aircraft.	6

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Aerospace Engineering

Pre-requisites:

1. Introduction to aerodynamics and flight mechanics principles.

Additional Reading:

1. Pamadi, B N., "Performance, Stability, Dynamics, and Control of Airplanes ", AIAA Education Series, 2004.
2. Etkin, B., "Dynamics of Atmospheric flight", Dover Publications , 1972, 2000.

Hyperlinks:

www.princeton.edu/~stengel/MAE331.html

Coordinators:

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LM6: Derivation of rigid body aircraft equations of motion.	2
LM7: Small perturbation theory.	1
LM8: Derivation of perturbed equations of motion of aircraft.	2
LM9: Decoupling of aircraft perturbed equations.	2
LM10: Review of Routh's stability criterion.	1
LM11: Aircraft longitudinal dynamics modes.	2
LM12: Aircraft lateral-directional dynamics modes.	3
LM13: Literal approximations to aircraft dynamics modes.	1
LM14: Introduction to flying and handling qualities of aircraft and stability augmentation systems.	2
LM15: Aircraft response to control or atmospheric inputs.	2
LM16: Introduction to aircraft autopilot design using classic control theory.	2
LM17: Introduction to nonlinear problems in aircraft flight dynamics. 1. Inertia coupling. 2. High angle of attack phenomena. 3. Flexibility effects. 4. Divergence.	2

LM : Lecture module

References:

1. Perkins C.D., & Hage, R.E. "Airplane perofrmance, stability and control", Wiley, 1974.
2. Nelson, R.C. "Flight Stability & Automatic Control", McGraw Hill, 1989.