AMITY UNIVERSITY
UTTAR PRADESH

Course Title: FLIGHT DYNAMICS **Credit Units: 03**

Course Code: AERO408

Course Level: UG

L	T	P/S	SW/ FW	TOTAL CREDIT UNITS
2	1	-	-	3

Course Objectives

This course is designed to make the students understand the complexities of airplane & rocket dynamics. Six degree of freedom analysis of Flight vehicles, along with stability and control aspects. A comprehensive analysis of aircraft motion and stability will be stressed upon in this course.

Pre-requisites: Aircraft stability & control, Airplane Performance.

Course Contents/Syllabus:

	Weightage (%)
Module I : Introduction	**15**
Descriptors/Topics*:* Fundamentals of vector. Particle and Rigid body kinematics: Fixed frame of reference, rotating frame of reference. Choice of Axes: principal axes, stability axes, body axes. Transformation of coordinates.	
Module II : Aircraft Equations of Motion	**25**
Descriptors/Topics : General equations of unsteady motion of airplane: Force equations in moving frame, Moment equations in moving frame. Orientation and position of the airplane: Principle Rotation, Euler angles, Euler rates, Transformation matrix. External forces. Angular velocities equations in moving frame. Velocities equations in moving frame. Flight simulation of powered and unpowered flights.	
Module III : Small-Disturbance Theory	**25**
Descriptors/Topics : Linearized equations of aircraft motion: Control fixed longitudinal equations, control fixed lateral-directional equations. Stability criteria. Stability analysis of linearized equations of motion. Airplane longitudinal motion: Short period approximation, Phugoid approximation. Airplane lateral motion: Spiral approximation, Roll approximation, Dutch roll approximation. Sample calculation on longitudinal and lateral motion approximations.	

Module IV : Stability Derivatives	**20**
Descriptors/Topics : Expressions for Cx, *and* Cz. The α Derivatives: $Cx_\alpha, Cz_\alpha, Cm_\alpha$. The u Derivatives: Cx_u, Cz_u, Cm_u. The q Derivatives: Cz_q, Cm_q. The $\dot{\alpha}$ Derivatives:. $C_{L\dot{\alpha}}$, $C_{m\dot{\alpha}}$. The β Derivatives: $C_{y\beta}, C_{l\beta}, C_{n\beta}$. The p Derivatives: C_{yp}, C_{lp}, C_{np}. The r Derivatives: C_{yr} , C_{lr}, C_{nr}.	
Module V : Fundamentals of Rocket Dynamics	**15**
Descriptors/Topics : Classification of rockets. Flight performance of single stage rocket. Design parameters. Performance in terms of design parameters. Flight performance of multi-stage rocket.	

Student Learning Outcomes:

- Develop 6DOF mathematical model to predict dynamic response of the flight vehicles.
- Define stability criterion of the flight vehicles.
- Differentiate and examine different modes of the aircraft motion.
- Evaluate and predict dynamic response of the flight vehicles corresponding to various control inputs
- Calculate performance of single and multi-stage rockets.

Pedagogy for Course Delivery: Session Plan / course-material uploading, Class-room teaching associated with assignments, presentations**,** quiz, viva-voce and evaluation.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	**NA**	**70**

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment - 30					End Term Examination
Components (Drop down)	**A**	**CT**	**S/V/Q**	**HA**	**70**
Weightage (%)	5	10	8	7	70

Text & References:

- Etkin, B., "*Dynamics of Flight*" 3rd Edition, John Wiley & Sons, INC.
- Meriam, J. L., "*Dynamics*" John Wiley & Sons, INC.
- Nelson, R. C., "*Flight Stability and Automatic Control"*, McGraw-Hill
- Roy, A. E., "*Foundation of Astrodynamics*", Macmillan.
- Kaplan, M. H., "*Spacecraft Dynamics and Control*", John Wiley & Sons, INC.

Any other Study Material:

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