AMITY UNIVERSITY
UTTAR PRADESH

Course Title : Flight Mechanics **Credit Units** : 04
Course Level **:** PG
Course Code : SPAC604

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	1	0	0	04

Course Objectives:

This course is designed to make the students understand the various aspect of aerodynamics forces and stability in flight, 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:

Mathematics & Physics (12^{th} level)

Course Contents/Syllabus:

	Weightage (%)
Module – I: Aerodynamic Characteristics	**10**
Drag Aerodynamics, Drag polar, Estimation of drag for complete airplane, Forces and moments from dimensional analysis, Pressure distribution over airfoils, variation with angle of attack, center of pressure, aerodynamic center and related problems. Estimation of C_L, C_D and C_m from pressure distribution.	
Module – II: Static and dynamic stability	**15**
Static and dynamic stability of the airplane, Stick fixed static longitudinal stability, Neutral point, Static Margin, Stick free static longitudinal stability, Lateral and directional static stability, Contribution of aircraft components to longitudinal, lateral and directional stabilities of the airplane.	

Module – III: Aircraft Equations of Motion	**25**
Fixed frame of reference, rotating frame of reference. Choice of Axes: principal axes, stability axes, body axes. Mathematical model of airplane dynamics, Orientation and position of the airplane, Principle Rotation, Euler angles and rates, Transformation matrix. Angular rates and velocities equations in moving frame. Flight simulation of powered and unpowered flights.	
Module – IV: Small-Disturbance Theory	**25**
Linearized equations of aircraft motion: Control fixed longitudinal, lateral and directional equations. Stability criteria. Stability analysis of linearized equations of motion. Airplane longitudinal motion: Short & Phugoid approximations and related problems. Airplane lateral motion: Spiral, Roll and Dutch roll approximations & related problems. Longitudinal and lateral-directional stability derivatives and their applications.	
Module – V: Fundamentals of Rocket Dynamics	**25**
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 (SLO):

On completion of the course the student will be able to:

- Describe various types of drag of the airplane.
- Explain longitudinal, lateral and directional stability in accelerated and steady flights.
- 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	**Nil**	**100**

Theory Assessment (L&T):

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

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text Books and References

- John D.Anderson, "Introduction to Flight", McGraw Hill.
- 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.
- ***Lecture notes:***