

ENGINEERING ANALYSIS OF FLIGHT VEHICLES

II Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BAEB12	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45		Tutorial Classes: Nil			Practical Classes: Nil			Total Classes: 45
I. COURSE OVERVIEW:								
<p>Computational science and engineering involves the development and use of computational methods to simulate, predict, and understand important phenomena in this subject. The aerospace field is characterized by the complexity of the environments in which its systems operate — a complexity driven not only by extreme physical conditions, but by interactions with humans and by the need for robust performance in these settings. Many physical aerospace phenomena, such as turbulent combustion in gas turbine engines, transonic flow around transport aircraft, rarefied gas dynamics and ablation processes in atmospheric reentry, and countless more, that are essential to aerospace systems are both inaccessible in the laboratory and analytically intractable. Since the earliest days of computational fluid dynamics and computational mechanics, enormous efforts have been devoted to the development of predictive computational models of these complex processes.</p>								
II. COURSE OBJECTIVES:								
The course should enable the students to:								
<ol style="list-style-type: none"> I. Analyze the key factors affecting vehicles configuration. II. Understand the basic concepts of gravitational terms in the equations of motion. III. Explain the concepts of static stability, trim static performance. IV. Analyze dynamic performance of spacecraft with respect to non-rotating planets. 								
III. COURSE OUTCOMES:								
After successful completion of the course, students will be able to:								
CO1	Identify the factors affecting vehicles configuration for determining its effect on flight characteristics.						Understand	
CO2	Develop the equation of motion for operation of vehicle relative to the ground and flight for rigid flight vehicles using Newton's laws.						Apply	
CO3	Construct the equation of motion of launch vehicle and spacecraft for static performance, impact of stability and control for the rotating planet.						Apply	
CO4	Demonstrate the perturbed longitudinal equation of motion for static and dynamic stability of rigid flight vehicles.						Analyze	
CO5	Inspect the impact of stability and design of longitudinal control of flight vehicles using numerical integration method.						Analyze	
CO6	Examine the gliding re-entry vehicle with respect to a rotating planet using equations of motion of launch vehicles for dynamic performance.						Understand	
IV. SYLLABUS:								
UNIT-I	THE MORPHOLOGY OF FLIGHT VEHICLES						Classes: 08	
Introduction, Key factors affecting vehicles configuration, Some representative flight vehicles.								

UNIT-II	EQUATIONS OF MOTION FOR RIGID FLIGHT VEHICLES AND INTRODUCTION TO VEHICLE AERODYNAMICS	Classes: 10
<p>Equations of Motion for Rigid Flight Vehicles: Definitions, Vector and Scalar realizations of Newton's second law, The tensor of inertia, Choice of vehicle axes, Operation of the vehicle relative to the ground; flight determination, Gravitational terms in the equations of motion, The state vector.</p> <p>Introduction to Vehicle Aerodynamics: Aerodynamics contributions to X, Y and M, dimensionless coefficients defined, equations of perturbed longitudinal motion.</p>		
UNIT-III	AIRCRAFT DYNAMICS AND STATIC STABILITY, TRIM STATIC PERFORMANCE AND RELATED SUBJECTS	Classes: 10
<p>Aircraft Dynamics: Equations of Motion of Aircraft including forces and moments of control surfaces, Dynamics of control surfaces.</p> <p>Static Stability, Trim Static Performance and Related Subjects: Impact of stability requirements on design and longitudinal control, Static performance.</p>		
UNIT-IV	DYNAMIC PERFORMANCE OF SPACECRAFT WITH RESPECT TO NON-ROTATING PLANETS	Classes: 09
<p>Introduction, Numerical integration of ordinary differential equations, Simplified treatment of boost from anon-rotating planet, An elementary look at staging, Equations of boost from a rotating planet.</p>		
UNIT-V	DYNAMIC PERFORMANCE OF SPACECRAFT AND DYNAMIC PERFORMANCE-ATMOSPHERIC ENTRY	Classes: 08
<p>Dynamic Performance of Spacecraft: Equations of Motion of Launch Vehicles with respect to a rotating planet, Motion of Spacecraft with respect to a rotating planet. Dynamic Performance-Atmospheric Entry: Equation of motion, Approximate analysis of gliding entry into a planetary atmosphere.</p>		
Text Books :		
1. Holt Ashley, "Engineering Analysis of Flight Vehicles", Dover Publications, 1992.		
Reference Books:		
1. J. D. Anderson, "Fundamentals of Aerodynamics", McGraw-Hill, 5 th Edition, 2001. 2. J. J. Bertin, R. M Cummings, "Aerodynamics for Engineers", Pearson, 5 th Edition, 2009. 3. Argyris G. Panaras, "Aerodynamic Principles of Flight Vehicles", AIAA Inc, 1 st Edition, 2012.		
Web References:		
1. https://mitpress.mit.edu/books/flight-vehicle-aerodynamics 2. https://www.edx.org/course/flight-vehicle-aerodynamics-mitx-16-110x-0 3. https://www.mooc-list.com/course/16110x-flight-vehicle-aerodynamics-edx?static=true		
E-Text Books:		
1. http://www.freeengineeringbooks.com/AeroSpace/Aerodynamics-Books.php 2. http://www.booksamillion.com/p/Flight-Vehicle-Aerodynamics/Mark-Drela/Q685536838 3. https://www.overdrive.com/media/1553992/flight-vehicle-aerodynamics		