FLIGHT MECHANICS

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB09	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. The fundamental principles of aerodynamics and propulsion for aircraft performance in classical flying stages.
II. The different regimes of aircraft and performance requirements at various atmospheric conditions.
III. The mathematical models for various types of maneuvers, safety requirements during takeoff, landing for better performance and stability.

COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 **Relate** the mission profiles of different types of aircrafts to get the performance characteristics.
CO 2 **Explain** about the force system of the aircraft and the development of equations using Newton's law of motion.
CO 3 **Classify** the different phases of design process from performance standpoint.
CO 4 **Illustrate** the cruise performance of an airplane in relation with range and endurance with different types of engines.
CO 5 **Relate** the effects of constant angle of attack, constant mach number, and constant altitude in cruise performance to notify the minimum, maximum speeds in flight.
CO 6 **Demonstrate** the concept of climb, descent performance along with energy height, specific excess power and energy methods for optimal conditions.
CO 7 **Illustrate** the power for best climb and descent performance and the effect of wind on climb and descent performance.
CO 8 **Compare** the aircraft manoeuvre performance in turn, pull-ups by considering limitations of power for military and civil aircrafts.
CO 9 **Develop** the mathematical model for the takeoff and landing distances to get runway characteristics.
CO 10 **Identify** the different types of fuel planning methods to calculate the trip fuel and taxi fuel.
CO 11 **Apply** the concept of aerodynamics and propulsion to estimate the safety factors for better performance of an airplane.
CO 12 **Examine** the various landing distances such as discontinued landing, baulk landing and air safety procedures, requirements on performance for better stability and control of the aircraft.

MODULE -I INTRODUCTION TO AIRCRAFT PERFORMANCE — Classes: 10

The role and design mission of an aircraft; Performance requirements and mission profile; Aircraft design performance, the standard atmosphere; Off-standard and design atmosphere; Measurement of air data; Air data computers; Equations of motion for performance - the aircraft force system; Total airplane drag- estimation, drag reduction methods; The propulsive forces, the thrust production engines, power producing engines,

variation of thrust, propulsive power and specific fuel consumption with altitude and flight speed; The minimum drag speed, minimum power speed; Aerodynamic relationships for a parabolic drag polar.

MODULE -II	CRUISE PERFORMANCE	Classes:08

Maximum and minimum speeds in level flight; Range and endurance with thrust production, and power producing engines; Cruise techniques: constant angle of attack, constant mach number; constant altitude, methods- comparison of performance. The effect of weight, altitude and temperature on cruise performance; Cruise performance with mixed power-Plants.

MODULE -III	CLIMB AND DECENT PERFORMANCE	Classes: 10

Importance of Climb and descent performance, Climb and descent technique generalized performance analysis for thrust producing, power producing and mixed power plants, maximum climb gradient, and climb rate.

Energy height and specific excess power, energy methods for optimal climbs - minimum time, minimum fuel climbs. Measurement of best climb performance. Descent performance in Aircraft operations. Effect of wind on climb and decent performance.

MODULE -IV	AIRCRAFT MANOEUVRE PERFORMANCE	Classes: 09

Lateral maneuvers- turn performance- turn rates, turn radius- limiting factors for turning performance. Instantaneous turn and sustained turns, specific excess power, energy turns. Longitudinal aircraft maneuvers, the pull-up, maneuvers. The maneuver envelope (V-n diagram), Significance. Maneuver boundaries and limitations, Maneuver performance of military Aircraft, transport Aircraft.

MODULE -V	SAFETY REQUIREMENTS -TAKEOFF AND LANDING PERFORMANCE AND FLIGHT PLANNING	Classes:08

Estimation of takeoff distances. The effect on the takeoff distance of weight wind, runway conditions, ground effect. Takeoff performance safety factors. Estimation of landing distances. The discontinued landing, Baulk landing, air safety procedures and requirements on performance. Fuel planning fuel requirement, trip fuel, Environment effects, reserve, and tinkering.

Text Books:

1. Anderson, J.D. Jr., ―Aircraft Performance and Design‖, International edition McGraw Hill, 1st Edition, 1999, ISBN: 0-07-001971-1.
2. Eshelby, M.E., ―Aircraft Performance theory and Practice‖, AIAA Education Series, AIAA, 2nd Edition, 2000, ISBN: 1-56347-398-4.

Reference Books:

1. McCormick, B.W, ‐Aerodynamics, Aeronautics and Flight Mechanics‖, John Wiley, 2nd Edition, 1995, ISBN: 0-471-57506-2.
2. Yechout, T.R. et al., ―Introduction to Aircraft Flight Mechanics‖, AIAA Education Series, AIAA, 1st Edition, 2003, ISBN: 1-56347-577-4.

Web References:

1. www.myopencourses.com/subject/flight-dynamics-i-airplane-performance
2. www.scribd.com/doc/185026212/Introduction-to-Flight-Third-Edition-by-John-D-Anderson-Jr
3. www.scribd.com/book/282507871/Performance-and-Stability-of-Aircraft
4. www.scribd.com/doc/203462287/Aircraft-Performance-NPTEL
5. www.nptel.ac.in/courses/101106041/

E-Text Books:

1. www.scribd.com/doc/97544751/Anderson-Aircraft-Performance-and-Design