AUTOMATIC CONTROL OF AIRCRAFT

PE - VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB49	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

This course is intended to study the automatic control of the flight vehicles through the air or inouter space. It concerns the forces and moments, that are acting on the air- vehicles to determine the position and attitude with respect to the time. It also develops as an engineering science throughout succeeding generations of aeronautical engineers to support increasing demands of autonomous aircraft navigation and control. It has a major role to play in the design of modern aircraft to ensure efficient, comfortable and safe flight. Modern aircraft control is ensured through automatic control systems known as autopilot in association with Fly-by-Wire, to increase safety, facilitate the pilot's taskeasier and improve flight qualities.

II. OBJECTIVES:

The course should enable the students to:

I	The fundamental theory of guidance and control systems of aircraft and alsodifferent augmentation systems used for aircraft and space vehicles.
II	Various components and propellants of a chemical rocket propulsion system withits characteristics and applications. Different autopilot systems, flight path stabilization and Automatic Flare Control systems used for flight vehicles.
III	The operating principle of guided missile, and the guidance, control and instrumentation needed to acquire the modern automatic control systems like Fly-by-Wire, Fly-by-Optics systems and different flight control laws design using different algorithms.
IV	Advanced computational tools to design of navigation and guidance systems for automation of aircrafts, missiles, helicopters and space launch vehicles.

III. COURSE OUTCOMES:

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

CO 1	**Identify** the principles of guidance, navigation, and governing lawsfor the control of aircraft for getting the desired aircraft attitude.	Apply
CO 2	**Demonstrate** the automatic flight control system under different types of flight conditions for assessing the stability and control of anairplane	Apply
CO 3	**Examine** the automatic gain schedule concept for airplane control by plotting the required curve f or obtaining desired automatic control of the flight vehicle.	Analyze
CO 4	**Apply** the concept of displacement autopilots and orientation control in longitudinal motion with its elements f or optimal flightautomated control of the airplane.	Apply
CO 5	**Make use of** the aircraft longitudinal flight control laws by usingsimple stepping algorithm for optimizing the required control of the flight vehicles.	Apply
CO 6	**Analyze** the fly-by-wire flight control by using flight control laws and modern computational tools system for the assessment of redundancy and failure of the aircraft operation.	Analyze

IV. SYLLABUS:

MODULE-I	INTRODUCTION	Classes: 04
Introduction to Guidance and control: Definition, historical background.		
MODULE-II	**AUGMENTATION SYSTEMS**	**Classes: 07**
Need for automatic flight control systems, stability augmentation systems, control augmentation systems, gain scheduling concepts.		

MODULE-III	LONGITUDINAL AUTOPILOT	Classes: 12
Displacement Autopilot: Pitch orientation control system, acceleration control system, glide slope coupler and automatic flare control. Flight path stabilization, longitudinal control law design using back stepping algorithm.		
MODULE-IV	**LATERAL AUTOPILOT**	**Classes: 10**
Damping of the dutch roll, methods of obtaining coordination, yaw orientation control system, turn compensation, automatic lateral beam guidance.		
MODULE-V	**FLY BY WIRE FLIGHT CONTROL**	**Classes: 12**
Introduction to Fly-by-wire flight control systems, fly-by-wire flight control features and advantages, control laws, redundancy and failure survival, digital implementation, fly-by-light flight control.		

Text Books:

1. Blake Lock, J.H, "Automatic control of Aircraft and missiles", John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, "Aircraft control & simulation", John Wiley Sons, New York, 1992.
3. Collinson R.P.G, "Introduction to Avionics", Chapman and Hall, 1st Edition India, 1996.

Reference Books:

1. Garnel.P. & East. D.J, "Guided Weapon control systems", Pergamon Press, Oxford, 1st Edition 1977.
2. Bernad Etikin, "Dynamic of flight stability and control", John Wiley, 1st Edition 1972.
3. Nelson R.C, "Flight stability & Automatic Control", McGraw Hill, 1st Edition 1989.

Web References:

1. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16...aircraft.../lecture-16
2. www.fsd.mw.tum.de/research/flight-control/
3. nptel.ac.in/courses/101108056/

E-Text Books:

1. https://books.google.co.in/books?isbn=1118870972
2. https://books.google.co.in/books?isbn=0387007261