AUTOMATIC CONTROL OF AIRCRAFT

I Semester: AE							
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**	
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BAEC06	**Elective**	3	-	-	3	30	70	100
ContactClasses: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 in outer 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 task easier and improve flight qualities.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamental theory of guidance and control systems of aircraft and also different augmentation systems used for aircraft and space vehicles
II. The different autopilot systems, flight path stabilization and Automatic Flare Control systems used for flight vehicles.
III. The modern automatic control systems like Fly-by-Wire, Fly-by-Optics systems and different flight control laws design using different algorithms.
IV. The 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 will be able to:

CO 1	**Explain** the historical perspective of guidance and control of the aircraft for assessing the rate of progress of these systems.	**Understand**
CO 2	**Discuss** the different types of control augmentation systems used in aircraft for estimating the control performance of the flight vehicle.	**Apply**
CO 3	**Examine** the automatic gain schedule concept for airplane control by plotting the required curve for obtaining desired automatic control of the flight vehicles.	**Apply**
CO 4	**Demonstrate**the acceleration control and automated flare control system using the back step algorithm for obtaining the state of automated control.	**Apply**
CO 5	**Apply**the mathematical model for the damping of the Dutch roll by using methods of coordination for the different types of air vehicles.	**Apply**
CO 6	**Analyze** the principles of automated control on lateral beam guidance system (LBGS) for aircraft's different flight modes.	**Analyze**

IV. COURSE SYLLABUS:

MODULE-I: INTRODUCTION (05)

Introduction to Guidance and control: Definition, historical background.

MODULE-II: AUGMENTATION SYSTEMS (07)

Need for automatic flight control systems, stability augmentation systems, control augmentation systems, gain scheduling concepts.

MODULE-III: LONGITUDINAL AUTOPILOT (10)

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 (11)

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 (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.

V. 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.

VI. REFERENCE BOOKS:

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

VII. 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/

VIII. E-TEXT BOOKS:

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