COURSE CONTENT

AUTOMATIC CONTROL OF AIRCRAFT								
VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAED50	**Elective**	3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Aircraft Stability and Control								

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. COURSES 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. Various components and propellants of a chemical rocket propulsion system with its 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:

At the end of the course students should be able to:

CO1 Identify the principles of guidance, navigation, and governing laws for the control of aircraft for getting the desired aircraft attitude
CO2 Demonstrate the automatic flight control system under different types of flight conditions for assessing the stability and control of an airplane
CO3 Examine the automatic gain schedule concept for airplane control by plotting the required curve f or obtaining desired automatic control of the flight vehicle
CO4 Apply the concept of displacement autopilots and orientation control in longitudinal motion with its elements f or optimal flight automated control of the airplane.
CO5 Make use of the aircraft longitudinal flight control laws by using simple stepping algorithm for optimizing the required control of the flight vehicles
CO6 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.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO AUTOMATIC CONTROLS (09)

Introduction to Guidance and control: Definition, historical background, purpose and functions, sensors, accelerometers. Types of guidance, phase of guidance, guided flight paths.

MODULE –II: AUGMENTATION SYSTEMS (09)

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

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 (10)

Damping of the Dutch roll, methods of obtaining coordination, yaw orientation control system, turn compensation, automatic lateral beam guidance. Classification of guidance systems.

MODULE –V: FLY BY WIRE FLIGHT CONTROL (10)

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", Pergamum 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

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation