FLIGHT SIMULATION AND CONTROLS LABORATORY

II Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BAEB19	Core	-	-	4	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 48				Total Classes: 36		

I. COURSE OVERVIEW:

Flight simulation and Control is the science that investigates the stability and control of aircrafts and all other flying vehicles. From the advent of the first flight by the Wright Brothers, it was observed that flight without knowledge of stability and control was not viable. Since then, several different concepts for controlling aircraft flight have been devised including control surfaces, deformable surfaces, morphing of wings etc. This course introduces some of these concepts and describes their operation, as well as the degree of stability that these devices can provide. Modern aircraft control is ensured through automatic control systems known as autopilot. Their role is to increase safety, facilitate the pilot's task and improve flight qualities. The course will introduce modern aircraft stability and control and discuss some of its objectives and applications

II. COURSE OBJECTIVES:

The course should enable the students to:

I. Understand the basics simulation of unaccelerated and accelerated level flight for climb and descend.

II. Analyze the takeoff and landing performance and ground roll for different modes of aircraft.

III. Identify the basic controls and maneuver of in complex flight Path.

III. COURSE OUTCOMES:

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

CO 1	**Choose** the appropriate flight path using flight simulator for simulating the un-accelerated and accelerated flights.	**Understand**
CO 2	**Estimate** the take-off velocity, ground roll distance, and landing distance using flight simulator for the Cessna aircraft.	**Apply**
CO 3	**Make use of** flight simulator's mission profiles for simulating the different flight maneuvers.	**Analyze**
CO 4	**Examine** the longitudinal and lateral perturbed stability of aircraft for obtaining desired operational ability.	**Apply**
CO 5	**Analyze** lateral and directional coupled dynamic stability for a given aircraft to simulate spin recovery.	**Apply**
CO 6	**Determine** turn rates, radius and barrel roll by using flight simulator for assessing flight performance in given condition.	**Analyze**

LIST OF EXPERIMENTS

Week-1 **SIMULATION OF UNACCELERATED AND ACCELERATED LEVEL FLIGHT**

Implement the following tasks

1. Simulation of steady flight
2. Simulation of accelerated level flight at various altitudes

Week-2	SIMULATION OF UNACCELERATED AND ACCELERATED CLIMB
Implement the following tasks 1. Simulation of steady climb 2. Simulation of accelerated climb at various climb rates	
Week-3	**SIMULATION OF UNACCELERATED AND ACCELERATED DESCENT**
Implement the following tasks 1. Simulation of steady descent 2. Simulation of accelerated descent at various descent rates	
Week-4	**SIMULATION OF TAKE-OFF PERFORMANCE**
Implement the following tasks 1 Estimation of takeoff velocity for Cessna flight.	
Week-5	**SIMULATION OF LANDING PERFORMANCE**
Implement the following tasks 1. Estimation of ground roll distance for Cessna flight 2. Estimation of total landing distance for Cessna flight	
Week-6	**SIMULATION OF CONVENTIONAL FLIGHT PATH**
Implement the following tasks 1. Perform the given mission profiles	
Week-7	**STABILIZATION OF LONGITUDINAL PERTURBED AIRCRAFT**
Implement the following tasks 1. Perform the operation from disturbed flight to trim flight	
2. Perform long period and short period modes.	
Week-8	**STABILIZATION OF LATERAL PERTURBED AIRCRAFT**
Implement the following tasks 1. Perform the operation from disturbed flight to trim flight 2. Simulate lateral directional modes.	
Week-9	**SIMULATION OF SPIN RECOVRY**
Implement the following tasks 1. Perform the operation of spin recovery	
Week-10	**SIMUILATION OF COORDINATED LEVEL TURN**
Implement the following tasks 1. Perform the level turn at given turn rate. 2. Perform the level turn at given turn radius.	
Week-11	**SIMUILATION OF BARREL ROLL MANEUVER**
Implement the following tasks 1. Perform the barrel roll maneuver	

Week-12	SIMULATION OF A COMPLEX FLIGHT PATH

Implement the following tasks

1. Perform flight simulation for given mission profiles

Reference Books:

1. Peter John Davison. "A summary of studies conducted on the effect of motion in flight simulator pilot training". 5th February 2014
2. Beard, Steven; et al. "Space Shuttle Landing and Rollout Training at the Vertical Motion Simulator" (PDF). AIAA. Retrieved 5th February 2014.

Web References:

1. www.helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf/
2. www.faa.gov/news/safety_briefing/2012/media/SepOct2012ATD.pdf
3. www.aerosociety.com/Assets/Docs/Publications/DiscussionPapers/The_impact_of_flight_simulation_in_aerospace.pdf