

## FLIGHT CONTROLS LABORATORY

**V Semester: AE**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE107	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
<b>Contact Classes: Nil</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: 36</b>			<b>Total Classes: 36</b>			

### I. COURSE OVERVIEW:

Flight controls laboratory is the science that investigates the performance of the aircraft as applied to flight vehicles and to provide a clear understanding of related topics, specifically on aerodynamics, propulsion, performance, stability and flight controls. The lab introduces the fundamental principles of aerodynamics and propulsion for aircraft performance in classical flying stages and the point of confluence of other disciplines with aeronautical engineering and the gateway to aircraft design.

### II. OBJECTIVES:

**The course should enable the students to:**

- I. Understand the basics simulation of uncelebrated 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
- IV. The aircraft equations of motion to correlate qualitatively with potential applications in aircraft stability in different degrees of freedom

### III. COURSE OUTCOMES:

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

- |      |   |          |
|------|---|----------|
| CO 1 | <b>Demonstrate</b> the accelerated and uncelebrated level flight by using MATLAB programming for steady and level flight and climb.       | Apply    |
| CO 2 | <b>Analyse</b> the equations of motion in 1-D and 2-D uncelebrated and accelerated climb by using MATLAB for steady descent and take-off. | Analyze  |
| CO 3 | <b>Estimate</b> the take-off and velocity and ground roll distance performance using simulator for the Cessna aircraft.                   | Evaluate |
| CO 4 | <b>Examine</b> the operation of disturbed flight to trimmed flight with given mission profile for long and short period modes.            | Analyze  |
| CO 5 | <b>Identify</b> the spin recovery modes and level turn radius by using MATLAB for coordinated level turns of the aircraft.                | Analyze  |
| CO 6 | <b>Compare</b> the barrel roll and maneuvered and simple maneuvered by using simulator for the Cessna aircraft.                           | Evaluate |

### IV. SYLLABUS:

#### LIST OF EXPERIMENTS

Week-1	SIMULATION OF UNACCELERATED AND ACCELERATED LEVEL FLIGHT
Implement the following tasks	
<ol style="list-style-type: none"> <li>Simulation of steady flight</li> <li>Simulation of accelerated level flight at various altitudes</li> </ol>	
Week-2	SIMULATION OF UNACCELERATED AND ACCELERATED CLIMB
Implement the following tasks	
<ol style="list-style-type: none"> <li>Simulation of steady climb</li> </ol>	

2. Simulation of accelerated climb at various climb rates	
<b>Week-3</b>	<b>SIMULATION OF UNACCELERATED AND ACCELERATED DESCENT</b>
Implement the following tasks 1. Simulation of steady descent 2. Simulation of accelerated descent at various descent rates	
<b>Week-4</b>	<b>SIMULATION OF TAKE-OFF PERFORMANCE</b>
Implement the following tasks 1 Estimation of takeoff velocity for Cessna flight.	
<b>Week-5</b>	<b>SIMULATION OF LANDING PERFORMANCE</b>
Implement the following tasks 1. Estimation of ground roll distance for Cessna flight 2. Estimation of total landing distance for Cessna flight	
<b>Week-6</b>	<b>SIMULATION OF CONVENTIONAL FLIGHT PATH</b>
Implement the following tasks 1. Perform the given mission profiles	
<b>Week-7</b>	<b>STABILIZATION OF LONGITUDINAL PERTURBED AIRCRAFT</b>
Implement the following tasks 1. Perform the operation from disturbed flight to trim flight 2. Perform long period and short period modes.	
<b>Week-8</b>	<b>STABILIZATION OF LATERAL PERTURBED AIRCRAFT</b>
Implement the following tasks 1. Perform the operation from disturbed flight to trim flight 2. Simulate lateral directional modes.	
<b>Week-9</b>	<b>SIMULATION OF SPIN RECOVERY</b>
Implement the following tasks 1. Perform the operation of spin recovery	
<b>Week-10</b>	<b>SIMULATION OF COORDINATED LEVEL TURN</b>
Implement the following tasks 1. Perform the level turn at given turn rate. 2. Perform the level turn at given turn radius.	
<b>Week-11</b>	<b>SIMULATION OF BARREL ROLL MANEUVER</b>
Implement the following tasks 1. Perform the barrel roll maneuver	
<b>Week-12</b>	<b>SIMULATION OF A COMPLEX FLIGHT PATH</b>
Implement the following tasks 1. Perform flight simulation for given mission profiles	
<b>Reference Books:</b>	
1. Peter John Davison. "A summary of studies conducted on the effect of motion in flight simulator pilot training". 2. Beard, Steven; et al. "Space Shuttle Landing and Rollout Training at the Vertical Motion Simulator" (PDF). AIAA. Retrieved 5 February 2014.	

**Web References:**

1. [www.helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf/](http://www.helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf/)
2. [www.faa.gov/news/safety\\_briefing/2012/media/SepOct2012ATD.pdf](http://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](http://www.aerosociety.com/Assets/Docs/Publications/DiscussionPapers/The_impact_of_flight_simulation_in_aerospace.pdf)

**Course Home Page:****SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:****SOFTWARE:** MAT Lab**HARDWARE:** 30 numbers of Desktop Computers with 4 GB RAM**LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:**

S.No	Details of Equipment	Quantity Required
1	Flight simulator	1
2	Live shares	18