INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

FLIGHT SIMULATION AND CONTROLS LABORATORY								
II Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BAED23	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Aerodynamics								

I. COURSE OVERVIEW:
The major emphasis of this course is to study the various flight maneuvering performance. The problems in different conditions of flight performance are demonstrated through either MATLAB-SIMULINK or Flight-Simulator. These tasks are performed to find the aerodynamic performance characteristics with variation of dependent parameters. SIMULINK Aerospace block set and tool kits are used to test various dependent parameters. Solid rocket propellant grain design will be simulated to test various burn rate and mission thrust reequipment.

II. COURSE OBJECTIVES:
The students will try to learn:

I. The utilization of MATLAB-SIMULINK and Flight-Simulator software to obtain the solution for complex and simple performance parametric conditions.
II. The involvement of various mathematical conditions.
III. The complex performance by using MATLAB-Simulator to determine the flight performance and stability criteria.

III. COURSE OUTCOMES:
After successful completion of the course, students will be able to:

CO 1 Apply the philosophy behind the flight performance and condition for recognizing the impacting parameters.
CO 2 Select the optimized condition for best performance.
CO 3 Identify the appropriate conditions for attaining the precise results aerospace vehicle.
CO 4 Choose the suitable numerical techniques and provide the economical solutions by using FLIGHT-SIMULATOR and MATLAB-SIMULINK.
CO 5 Analyze mission critical problems using MATLAB/SIMULINK Software's and FLIGHT SIMULATOR.
CO 6 Make use of MATLAB/SIMULINK Software's and FLIGHT SIMULATOR.

IV. COURSE CONTENT:

Week-1: INTRODUCTION
Introduction to various mission and aircraft performance theories, conditions and methodologies used in SIMULINK and FLIGHT-SIMULATOR. Applications of mission critical operation for classical problems.

Week-2: INTRODUCTION TO MATLAB-SIMULINK AND FLIGHT SIMULATOR
Introduction to MATLAB features, Aerospace block set, aerospace tool kit and simulator's suitable conditions

Week-3: INTRODUCTION TO MATLAB/SIMULINK SOFTWARE'S AND FLIGHT SIMULATOR

Various menu items, functions and features availability in MATLAB/SIMULINK Software's and FLIGHT SIMULATOR.

Week-4: SIMULATION THROUGH MATLAB/SIMULINK SOFTWARE'S AND FLIGHT SIMULATOR

Building required block set for certain operation in MATLAB-SIMULINK and operation of sticks and pedal in FLIGHT-SIMULATOR.

Week-5: SIMULATION OF STEADY LEVEL FLIGHT AND SIMULATION OF ACCELERATED LEVEL FLIGHT (USING FLIGHT-SIMULATOR)

Runway activity, taxing, take-off and making level flight will be performed in FLIGHT-SIMULATOR.

Week-6: SOLID ROCKET PROPELLANT MOTOR BURNING ANALYSIS (USING MATLAB-SIMULINK)

Design of block set, fixing the burning rate and thrust obtain the thrust computation plot are the major activity.

Week-7: PERFORM THE OPERATION OF SPIN RECOVERY (USING FLIGHT-SIMULATOR)

Analyze the aerodynamic principles behind spins and stalls recovery which is crucial for pilots to make informed decisions during real-world scenarios.

Week-8: PERFORM THE LEVEL TURN AT GIVEN TURN RATE & PERFORM THE LEVEL TURN AT GIVEN TURN RADIUS (USING FLIGHT-SIMULATOR)

Investigate the effects of different turn rates and turn radii on the flight characteristics of an aircraft during level turns and analyze the collected data to observe trends and relationships between turn rate, turn radius, bank angle, and other relevant parameters.

Week-9: PERFORM FLIGHT SIMULATION FOR GIVEN MISSION PROFILES (USING FLIGHT-SIMULATOR)

Create the scenarios that align with the different mission profiles of scenarios that include emergency situations, search and rescue missions, or precision landing.

Week-10: PERFORM THE STABILIZATION OF LONGITUDINAL PERTURBED AIRCRAFT (USING FLIGHT-SIMULATOR)

Evaluate the severity and nature of the perturbation and determine whether it's a transient disturbance or a sustained deviation that requires immediate correction. Confirm that the aircraft has returned to straight and level flight, and assess whether any additional adjustments are needed to maintain stability.

Week-11: PERFORM THE STABILIZATION OF LATERAL PERTURBED AIRCRAFT (USING FLIGHT-SIMULATOR)

Choose an aircraft in your flight simulator that is designed for aerobatics or has the capability to perform rolls. This could be a high-performance, aerobatic, or stunt plane.

Week-12: UNDAMPED STABILITY (USING MATLAB-SIMULINK)

Examine the pole and zero locations of a dynamic system using MATLAB. Examine the effect of stability margins on closed-loop response characteristics of a control system by assessing Gain and Phase Margins.

Week-13: PERFORM THE SPIN RECOVERY (USING FLIGHT-SIMULATOR)

Create the scenarios where spin happens and recover from spin.

Week-14: PERFORM THE DUTCH ROLL RECOVERY (USING FLIGHT-SIMULATOR)

Create the scenarios where Dutch roll happens and recover from it.

V. TEXT BOOKS:

1. Brian L. Stevens, Frank L. Lewis - Aircraft Control and Simulation-Wiley 3rd Edition- (2016).
2. An interactive introduction to MATLAB, The University of Edinburgh, School of Engineering (2016).

VI. REFERENCE BOOKS:

1. A MATLAB Exercise Book by Ludmila I. Kuncheva and Cameron C. Gray, ISBN 978-0-244-25328-8 2nd edition, 2016.

VII. ELECTRONICS RESOURCES:

1. https://in.mathworks.com/support/learn-with-matlab-tutorials.html

VIII. MATERIALS ONLINE

1. Course template
2. Lab manual