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

AERONAUTICAL ENGINEERING
COURSE DESCRIPTION

Course Title	Flight simulation and Controls Laboratory				
Course Code	BAED23				
Program	M.Tech				
Semester	II				
Course Type	Laboratory				
Regulation	MT-23				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. K Arun Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AAED08	IV	Aerodynamics
B.Tech	AAEC16	V	High Speed Aerodynamics
B.Tech	AAED25	VI	Computational Aerodynamics

II 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

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Flight simulation and Controls Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each lab will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being a internal examiner and another is external examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.
All the drawing related courses are evaluated in line with lab courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks each in a semester.
The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

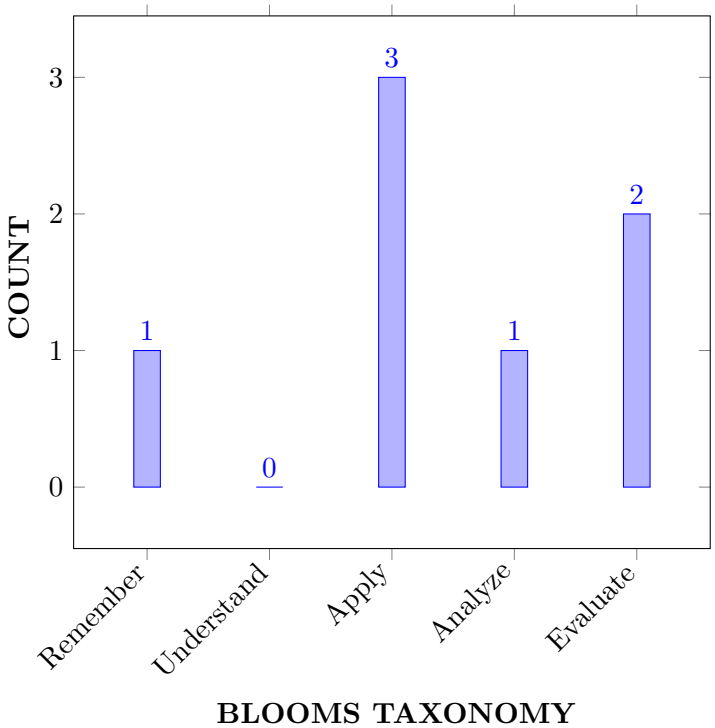
I	The utilization of MATLAB-SIMULINK and Flight-Simulator software to obtain the solution for complex and simple performance parametric conditions.
II	The involvement of various mathematical conditions.
III	The complex performance by using MATLAB-Simulator to determine the flight performance and stability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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	Identify, formulate, analyze and Design complex engineering problems, and design system components or processes by applying appropriate advanced principles of engineering activities and using modern tools
PO 2	Engage in life-long learning and professional development through self-study and continuing education in understanding the engineering solutions in global and management principles to manage projects in multidisciplinary environments.
PO 3	Demonstrate a degree of mastery in emerging areas of Aerospace Engineering such as Aerodynamics, Propulsion, Structure and Flight Dynamics
PO 4	Write and present a substantial technical report/document
PO 5	Independently carry out research/investigation and development work to solve practical problems
PO 6	Function effectively as a member or leader in diverse teams to carry out development work, produce solutions that meet the specified needs with frontier technologies and communicate effectively on complex engineering activities.

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO1	Identify, formulate, analyze and Design complex engineering problems, and design system components or processes by applying appropriate advanced principles of engineering activities and using modern tools	2	CIE, SEE
PO3	Demonstrate a degree of mastery in emerging areas of Aerospace Engineering such as Aerodynamics, Propulsion, Structure and Flight Dynamics	2	CIE, SEE
PO4	Write and present a substantial technical report/document	1	CIE, SEE
PO 5	Independently carry out research/investigation and development work to solve practical problems	2	CIE, SEE

3 = High; 2 = Medium; 1 = Low

X MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	-	2	1	2	-
CO 2	2	-	2	1	2	-
CO 3	2	-	2	1	2	-
CO 4	2	-	2	1	2	-
CO 5	2	-	2	1	2	-
CO 6	2	-	2	1	2	-

XI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIII SYLLABUS:

WEEK I	**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 II	**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 III	**SIMULATION OF UNACCELERATED AND ACCELERATED DESCENT**
	Implement the following tasks 1. Simulation of steady descent 2. Simulation of accelerated descent at various descentrates
WEEK IV	**SIMULATION OF TAKE-OFF PERFORMANCE**
	Implement the following tasks 1. Estimation of take off velocity for Cessna flight.
WEEK V	**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 VI	**SIMULATION OF CONVENTIONAL FLIGHT PATH**
	Implement the following tasks 1. Perform the given mission profiles
WEEK VII	**STABILIZATION OF LONGITUDINAL PER TURBED AIRCRAFT**
	Implement the following tasks 1. Perform the operation from disturbed flight to trim flight 2. Perform long period and short period modes.

WEEK VIII	**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 IX	**SIMULATION OF SPIN RECOVERY**
	Implement the following tasks 1. Perform the operation of spin recovery
WEEK X	**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 XI	**SIMUILATION OF BARREL ROLL MANEUVER**
	Implement the following tasks 1. Perform the barrel roll maneuver
WEEK XII	**SIMULATION OF A COMPLEX FLIGHT PATH**
	Implement the following tasks 1. Perform flight simulation for given mission profiles

TEXTBOOKS

1. Peter John Davison, —A summary of studies conducted on the effect of motion in flight simulator pilot training", 5th February, 2014.

REFERENCE BOOKS:

1. Vepa, R., —Flight Dynamics, Simulation and Control: For Rigid and Flexible Aircraft‖, CRC Press, Taylor and Francis Group, 2015.
2. Wayne Durham, —Aircraft Flight Dynamics and Control‖, CRC Press, 2nd Edition, 2013.
3. RobertF.Stengel —Flight Dynamics‖, CRC Press, 2nd Edition, 2013.

XIV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	simulation of unaccelerated and accelerated level flight	CO 1	T1: 2.3
2	simulation of unaccelerated and accelerated climb	CO 1	T1: 2.6
3	simulation of unaccelerated and accelerated descent	CO 1	T1: 2.6
4	simulation of take-off performance	CO 2	T1: 2.7
5	simulation of landing performance	CO 2	R1: 2.22
6	simulation of conventional flight path	CO 3	R1: 2.25
7	stabilization of longitudinal perturbed aircraft	CO 4	R1: 2.55
8	stabilization of lateral perturbed aircraft	CO 4	R1: 2.3
9	simulation of spin recovery	CO 5	R1: 2.6
10	simulation of coordinated level turn	CO 6	R1: 2.8
11	simulation of barrel roll maneuver	CO 6	R1:2.18
12	simulation of a complex flight path	CO 3	R3:5.22

XV EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Simulation of Acclerated and unacclerated flight during various flight conditions
2	Simulation of landing and take off performance of Cessna 172 Skyhawk
3	Simulation of Low level strike profile
4	Simulation of hall roll, split S and Loop profile flight
5	Simulation of cobra maneuvering

Signature of Course Coordinator **HOD, AE**
Mr. K Arun Kumar, Assistant Professor