COMPUTATIONAL AEROSPACE ENGINEERING LABORATORY

I Semester: AE								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BAEC12	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorials Classes: Nil**	**Practical Classes:36**				**Total Classes:36**		

I. COURSE OVERVIEW:

This course aims to enhance the skills through a detailed introduction to the state-of-the-art computational methods and their applications for digital age aerospace engineering applications. It provides a unique opportunity for cross-disciplinary education and knowledge transfer in the computational engineering of fluid and solid mechanics for aerospace industrial applications. Focusing on fully integrated digital design for aerospace applications, you will be able to understand and implement numerical methods on various computing platforms for aerospace applications.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basic MATLAB software and use them to solve structural aero dynamic and flight control system problems.
II. Basics of plotting in MATLAB both in two dimensional and three dimensional.
III. Coding for solving structural response problems, aerodynamic simulation problems and flight control system analysis and design.

III. COURSE OUTCOMES:

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

CO1	**Make use of** MATLAB and Simulink tools for solving aerospace engineering problems in designing.	**Apply**
CO2	**Examine** the thin-walled beams and shells using finite element method for analyzing the bending stiffness of aircraft structure.	**Analyze**
CO3	**Solve** the Burger's equation using explicit Mac Cormack method for analyzing fluid flows.	**Analyze**
CO4	**Develop** the numerical code for solving laminar flow over a flat plate.	**Analyze**
CO5	**Make use of** MATLAB and Simu-link for simulating the motion of aircraft and re-entry vehicles.	**Analyze**
CO6	**Build** the mathematical model by using different techniques for simulating satellite attitude dynamics.	**Analyze**

IV. LIST OF EXPERIMENTS:

Week-1: MATLAB/SIMULINK FUNDAMENTALS FOR AERO SPACE APPLICATIONS

MATLAB introduction, Plotting and graphics: Plot, log and semi-log plots, polar plots; Subplots, axis,mesh,contourdiagrams,flowdiagrams,movies,MATLABtoolboxes:continuoustransferfunctions,root locus, Nichols chart, Nyquist chart, linear quadratic regulator, state space design, digital design, aerospace toolbox; M cells, structures and M-files, MEX files; Standard simulink libraries, simulink aerospace blockset, Building simulink linear models: transfer function modelling in simulink, zero polemodel, state-space model; simulink LTI viewer and usage of it, equivalent simulink LTI models, single input single output design tool, building Multi-input, multi output models, building simulink S-functions; State flow introduction: Opening, executing, and saving state flow models, constructing a simple state flow model, using a state flow truth table.

Week-2: THIN WALLEDBEAMS

Software development for thin walled beams using finite element method.

Week-3: PLATE BENDING

Software development for Plate bending using finite element method.

Week-4: BEAMS ANALYSIS

Software development for Beams analysis using finite element method.

Week-5: TRUSSES ANALYSIS

Software development for Trusses analysis using finite element method.

Week-6: THIN SHELLS ANALYSIS

Software development for Thin shells analysis using finite element method.

Week-7: GENERATION OF STRUCTURES AND UNSTRUCTURED

Software development for simulation in generation of structures and unstructured grids in two and three dimensions of fluid flows.

Week-8: SOLUTION OF BURGERS EQUATION

Software development for simulation in solution of burgers equation using explicit McCormack method of fluid flows.

Week-9: BLASIUS SOLUTION FOR LAMINAR BOUNDARY LAYER OVER A FLAT PLATE

Software development for simulation in Blasius solution for laminar boundary layer over a flat plate of fluid flows

Week-10: RIEMANN SOLVER FOR SHOCK TUBE PROBLEM

SoftwaredevelopmentforsimulationinRiemannsolverforshocktubeproblemoffluidflows.

Week-11: SIMULATION OF AIRCRAFT MOTION

Simulation experiment in dynamics and control using MATLAB and simulink to Simulate aircraft motion such as longitudinal dynamics, lateral dynamics.

Week-12: SIMULATION OF AIRCRAFT MOTION WITH ILLUSTRATION OFF-16 MODEL

Six-degrees-of-freedom simulation of aircraft motion with illustration of F-16 model using MATLAB and simulink.

Week-13 SIMULATION OF RE-ENTRY VEHICLE DYNAMICS

Simulation of re-entry vehicle dynamics for ballistic re-entry and maneuvering re-entry.

Week-14: SIMULATION OF NON-LINEAR CONTROL SYSTEM

Simulation of non-linear control system for controlling roll dynamics of a fighter aircraft.

Week-15: SIMULATION OF SATELLITE ATTITUDE DYNAMICS

Simulation of the following relating to satellite attitude dynamics:

a Torque free rotation of axi symmetric and asymmetric space craft.

b. Attitude maneuvers of spin-stabilized spacecraft.

V. REFERENCE BOOKS:

1. Richard Colgren, "Basic MATLAB, Simulink, and State Flow", AIAA Education Series, 1st Edition, 2007.
2. StevenT.Karris, "Introduction to Simulink with Engineering Application", Orchard Publication, 3rd Edition, 2006.

3. AshishTewari, “Atmospheric and Space Flight Dynamics”, Birkha user Publication, 1st Edition, 2007.
4. A.Tewari, “Modern Control Design with MATLAB and Simulink”, Wiley, 1st Edition, 2002.

VI. WEB REFERENCES:

1. http://www.springer.com/us/book/9780817644376
2. https://www.scribd.com/doc/53680598/Modern-Control-Design-With-MATLAB-and-SIMULINK