COURSE CONTENT

COMPUTATIONAL AERODYNAMICS AND TURBULENCE MODELLING LABORATORY								
VI Semester: AE								
Course Code	**Category**	**Hours /Week**			**Credits**	**MaximumMarks**		
AAED39	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Aerodynamics								

I. COURSE OVERVIEW:

Computational Structural Analysis Laboratory sessions focus on the creation of geometry, meshing (Discretization) and the physics behind the stress strain variation on a continuum. It will also cover the different solvers available in a FEA package and their applications based on the problem type. This course offers a wide range of applications in aircraft structural analysis such as deflection of truss, frames, beams, stress and strain distributions in a plate as well as a solid continuum. Apart from these, it will also address the nonlinear stress problems alongside vibration and flutter analysis

II. COURSE OBJECTIVES:

The students will try to learn:

I. The latest computational techniques and software used for structural analysis.
II. The how real-life structures behave under static and dynamic loads.
III. The professional and contemporary issues in the design and fabrication of aerospace structures.

III. COURSE OUTCOMES:

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

CO 1 Explain the computational methods and Software's that are used in aerospace fields to simulate the complex problems through ANSYS.
CO 2 Solve the parameters like deflections, stress, strain and bending moment by using ANSYS for the linear and non-linear problems that occur in aircraft structural components (beams, bars etc.).
CO 3 Calculate the numerical solution of static structural problems using discretization methods and convergence criteria to minimize the errors.
CO 4 Select the appropriate heat transfer mechanism using ANSYS thermal workbench for efficient cooling of on-board avionics system
CO 5 Predict the suitable appropriate results using governing equations for vibrational problems that occur in aircraft structural components (beams, spring-mass system)
CO 6 Determine the nature of stress-strain distribution by using appropriate governing equations for an aircraft structural component such as wings, fuselage and landing gear.

IV. COURSE CONTENT:

Week-1: INTRODUCTION AND BASIC FUNCTIONS
Starting up of ANSYS- Description of user interface

Week-2: INTRODUCTION TO TURBULENCE MODELLING
Introduction to turbulence modelling, the major theories, approaches and methodologies used in turbulence modelling. Applications of turbulence modelling for classical aerodynamics' problems.

Week-3: FLOW OVER A FLAT PLATE
Flow over a flat plate at low Reynolds numbers, observe the boundary layer phenomena, no slip condition and velocity profile inside the boundary layer.

Week-4: FLOW THROUGH PIPE
Flow through pipe at different Reynolds numbers; observe the velocity changes for laminar and turbulent flows.

Week-5: FLOW OVER A CIRCULAR CYLINDER
Flow over a circular cylinder at different Reynolds numbers, observe the properties at separation region and wake region.

Week-6: FLOW OVER A CAMBERED AEROFOIL
Flow over a cambered aerofoil at different Reynolds number, observe flow properties and compare the computation results with experimental results

Week-7: FLOW OVER A SYMMETRIC AEROFOIL
Flow over a symmetric aerofoil at different Reynolds number, observe flow properties and compare the computation results with experimental results.

Week-8: FLOW OVER WEDGE
Flow over wedge body at supersonic Mach number; observe the shock wave phenomena and change of properties across the shock wave.

Week-09: FLOW OVER A CONE
Flow over a cone at supersonic Mach number; observe the shock waves and 3D relieving effect.

Week-10: FLOW ANALYSIS OF AIRCRAFT STRUCTURE: WING
Flow over a wing at different Reynolds number, observe flow properties and compare the computation results with experimental results

Week-11: COMPRESSIBLE FLOW IN A NOZZLE
Flow over a nozzle at different Reynolds number and temperature, observe flow properties and compare the computation results with experimental results.

Week-12: CODE DEVELOPEMENT
Solution for the following equations using finite difference method One dimensional wave equation using explicit method of lax. One dimensional heat conduction equation using explicit method

Week-13: CODE DEVELOPEMENT
Generation of the following grids Algebraic grids. Elliptic grids.

Week-14: CODE DEVELOPEMENT

Solution for the following equations using finite difference method linear convection equation by Lax Wendroff Scheme.

V. REFERENCE BOOKS:

1. Huei-Huang Lee, "Finite Element Simulations with ANSYS Workbench 16", SDC publications, 2nd Edition, 2016.
2. Anderson, William J, "MSC/Nastran: Interactive Training Program", Wiley, 1st Edition 2015.

VI. ELECTRONICS RESOURCES:

1. https://www.scribd.com/doc/311680146/eBook-PDF-Cfd-Fluent.
2. https://cfd.ninja/tutorials/ansys-fluent
3. https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules

VII. MATERIALS ONLINE

1. Course template
2. Lab manual