ADVANCED COMPUTATIONAL AERODYNAMICS LABORATORY

I Semester: AE								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BAEC11	**Core**	-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes:36**				**Total Classes:36**		

I. COURSE OVERVIEW:

The major emphasis of this course is to solve a complex geometrical structures under a given loads, these methods does not have analytical solutions. Software's like ANSYS and NASTRAN is utilized to interpret results for complex geometries. Modeling of crack and composite structures help the students to solve realistic problems which are common in industries. Structural analysis on aircraft structures and Rocket components are delt to obtain the solution for bending and torsion under the applied aerodynamic loads.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The utilization of ANSYS and NASTRAN software to obtain the solution for complex geometrical structures.
II. The mathematical methods involved in structural mechanics along with its strengths and weakness.
III. Modeling a structural crack in ANSYS and NASTRAN and determine its failure loads.
IV. Modeling a complex composite structure in ANSYS and NASTRAN and determine the stresses and strains.

III. COURSE OUTCOMES:

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

CO 1	**Apply** the philosophy behind the computational fluid dynamics for recognizing flow properties in solving fluids and heat transfer problems.	**Apply**
CO 2	**Select** the structured, unstructured mesh and multi-blocking strategy in basic, complex geometries and flow domains for computing aerodynamic characteristics.	**Apply**
CO 3	**Identify** the appropriate physical boundary conditions for attaining the precise results of fluid flow over a body.	**Understand**
CO 4	**Choose** the suitable numerical modeling and schemes for computational simulations of aerodynamics and thermo-fluid problems using ANSYS.	**Understand**
CO 5	**Analyze** the numerical solution of fluid flow problems using flow visualization Software's for recognizing the flow physics in and around the supersonic intake and free jet.	**Analyze**
CO 6	**Develop** the numerical code for one dimensional heat and wave equation using explicit finite difference method.	**Apply**

IV. LIST OF EXPERIMENTS:

Week-1: INTRODUCTION

Introduction to computational aerodynamics, the major theories, approaches and methodologies used in computational aerodynamics. Applications of computational aerodynamics for classical aerodynamics problems.

Week-2: INTRODUCTION TO ANSYS CFX
Introduction to gambit, geometry creation, suitable meshing types and boundary conditions.

Week-3: INTRODUCTION TO ANSYS FLUENT
Introduction to fluent, boundary conditions, solve conditions and post processing results.

Week-4: FLOW THROUGH NOZZLE
Flow Through Nozzle

Week-5: FLOW THROUGH SUPER SONIC INTAKE
Flow Through Supersonic Intake

Week-6: SUPERSONIC FREEJET
Flow over a Supersonic Free Jet

Week-7: SHOCK BOUNDARY LAYER INTERACTION
Shock Boundary Layer Interaction

Week-8: FLOW OVER A RE-ENTRY VEHICLES
Flow over a re-entry vehicle

Week-9: SUPER SONIC FLOW OVER A CONE
Flow over wedge body at supersonic Mach number; observe the shock wave phenomena and change of properties across the shockwave.

Week-10: THERMAL TESTING TURBINE BLADE
Flow over a Missile body

Week-11: CASCADE TESTING COMPRESSOR BLADE
1. Solution for the following equations using finite difference method
2. One dimensional wave equation using explicit method of lax.

Week-12: HEAT CONDUCTION
1. One dimensional heat conduction equation using explicit method.

V. REFERENCE BOOKS:

1. Anderson, J.D., Jr., Computational Fluid Dynamics the Basics with Applications, McGraw-Hill Inc, 1st Edition, 1998.
2. Hoffmann, K. A. and Chiang, S. T., "Computational Fluid Dynamics for Engineers", 4th Edition, Engineering Education Systems (2000).
3. Hirsch,C., "Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics", Vol. I, 2nd Edition, Butterworth-Heinemann (2007).
4. JAF.Thompson, Bharat K.Soni, NigelP. Weatherill, "Grid Generation", 1st Edition, 2000.

IV. WEB REFERENCES:

1. https://www.scribd.com/doc/311680146/eBook-PDF-Cfd-Fluent.