# FLUID THERMAL MODELING AND SIMULATION LABORATORY

**VI Semester: ME**

| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CIA | SEE | Total |
| AME113 | Core | - | - | 3 | 2 | 30 | 70 | 100 |
| Contact Classes: Nil | Tutorial Classes: Nil | Practical Classes: 42 | | | | Total Classes: 42 | | |

**OBJECTIVES:**

The **course should enable the studentsto:**

I. Analyze the fluid flow throughpipes.
II. Understand the external fluidflow.
III. Apply simulation techniques to heat flowproblems.
IV. Evaluate the thermal stresses of real timeproblems.
V. Demonstrate the 3D Heat conduction for real timeproblems.

**COURSE OUTCOMES (COs):**

CO 1 Understand and apply finite element methods to fluid flow problems.
CO 2 Understand various types of fluid flow and able to apply basic fundamental equations applied to fluid flow usingANSYS and MAT lab.
CO 3 Use the modern tools to formulate the problem, and able to create geometry and discretize, apply boundary condition to solve problems using ANSYS.
CO 4 Analyze heat transfer coefficient on different surfaces, components and design of heat exchanging equipment
CO 5 Understand 3-D thermal analysis and flow simulation using ANSYS

**COURSE LEARNING OUTCOMES (CLOs):**

**The students should enable to:**

1 Understand basic units of measurement, convert units, and appreciate their magnitudes.
2 Understand the basic principles ofFEM
3 Utilize the governing equation for solving the fluid flow through pipe
4 Model the 3D pipe flow domain using Ansys
5 Mesh the 3D pipe flow domain usingAnsys
6 Validate the results of analytical models introduced in lecture to the actual behavior of real fluidflows
7 Plot the variation velocity through the branch of pipes using Mat lab
8 Learn the creation of geometry using keypoint
9 Plot the analysis of external fluid flowproblem
10 Determine the skin friction coefficient of rectangular plate.
11 Modelling and assemble of ballvalve
12 Simulation of flow through ballvalve
13 Plot the temperature distribution through the solid using Ansys APDL
14 Plot the vector distribution of thermal gradient and thermal flux ofsolid
15 Temperature distribution of fine element.
16 Treatment of boundaryconditions.
17 Plot the 3Dheat conductiondistribution.
18 Calculation of the efficiency of the counter flow heat exchanger using Ansys FlowSimulation.
19 Conjugate heat transfer problem using Ansys Flow Simulation.
20 3D Thermal Analysis, Finned Pipe usingAnsys
21 Thermal stress analysis ofpiston
22 Plot the nodal as well elemental distribution of processparameters

| LIST OF EXPERIMENTS | |
|---|---|
| **Week-1** | **INTERNAL PIPE FLUID FLOW – FEM** |
| Internal Pipe flow problem Using theoretical FEM. | |
| **Week-2** | **INTERNAL PIPE FLUID FLOW - ANSYS** |
| Analyzing Flow in a System of Pipes using ANSYS. | |
| **Week-3** | **INTERNAL PIPE FLUID FLOW – MATLAB** |
| Internal Pipe flow problem using MAT LAB. | |
| **Week-4** | **EXTERNAL FLUID FLOW** |
| Determination of the skin friction coefficient of a plate in a uniform fluid stream using ANSYS - Flow Simulation. | |
| **Week-5** | **FLOW THROUGH BALL VALVE** |
| Flow of water through a ball valve assembly using ANSYS/ SolidWorks Flow Simulation. | |
| **Week-6** | **HEAT CONDUCTION** |
| Heat Conduction within a Solid using ANSYS. | |
| **Week-7** | **TEMPERATURE DISTRIBUTION** |
| Temperature distribution in a fin cooled electronic component using ANSYS. | |
| **Week-8** | **3D HEAT CONDUCTION** |
| 3D Heat Conduction within a Solid-Cell Phone using ANSYS. | |
| **Week-9** | **COUNTER FLOW HEAT EXCHANGER** |
| Calculation of the efficiency of the counter flow heat exchanger using ANSYS/SolidWorks Flow Simulation. | |
| **Week-10** | **CONJUGATE HEAT TRANSFER** |
| Conjugate heat transfer problem using ANSYS/ Solid Works Flow Simulation. | |
| **Week-11** | **3D THERMAL ANALYSIS** |
| 3D Thermal Analysis, Finned Pipe using ANSYS. | |
| **Week-12** | **THERMAL STRESS ANALYSIS** |
| Thermal stress analysis of piston. | |
| **Text Books:** | |
| 1. Janna, W.S., “Design of Fluid Thermal Systems”, Cengage Learning, 3rd Edition, 2011.<br>2. Jaluria, Y., “Design and Optimization of Thermal Systems”, McGr aw-Hill, 2nd Edition, 2007. | |
| **Reference Books:** | |
| 1. Suryanarayana, N. V. and Arici ,“Design and Simulation of Thermal Systems”, McGraw-Hill, 1st Edition, 2003. | |
| 2. McDonald, A. G., and Magande, H. L., “Thermo-Fluids Systems Design”, John Wiley, 1st Edition, 2012 | |
| 3. Robert Cook, “Concepts and Applications of Finite Element Analysis”, Wiley, 1st Edition, 2013. | |