INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**FLUID THERMAL, MODELLING & SIMULATION LABORATORY**				
Course Code	AME113				
Programme	B.Tech				
Semester	VI	ME			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Chief Coordinator	Ms. N SanthiSree, Assistant Professor				
Course Faculty	Ms. N SanthiSree, Assistant Professor Mr. G Aravind Reddy, Assistant Professor				

I. COURSEOVERVIEW:

The ANSYS software has different modulus (Ansys APDL and workbench etc...). The Workbench environment is an intuitive up-front finite element analysis tool that is used in conjunction with CAD systems and/or Design Modeler. ANSYS Workbench is a software environment for performing structural, thermal, and electromagnetic analyses. The laboratory sessions are focuses on geometry creation, meshing and how to apply the boundary conditions, attaching existing geometry, setting up the finite element model, solving, and reviewing results. The lab sessions will describe how to use the basic finite element simulation concepts and resultsinterpretation.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	AME004	III	Mechanics of Solids	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIAExamination	Total Marks
Fluid Thermal, Modelling and simulation Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✘	Videos
✔	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

Each laboratory 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 today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the simulation calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

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 labassessment.

Table 1: Assessment pattern for CIA

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 hoursduration.

Preparation	**Performance**	**Analysis and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an Engineering specialization to the solution of complex engineering problems.	2	Calculations of the nodal parameters
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems Reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Simulation plots, graphs and curves
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs withappropriateconsiderationforthepublichealthand Safety, and the cultural, societal, and environmental considerations.	2	Calculations of the elemental parameters
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid Conclusions.	2	Case study analysis

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineeringstreams.	1	Model meshing
PSO 2	**Modelling and Simulation Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	2	Model analysis
PSO 3	**Successful career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to becometechnocrats.	2	Case study meshing techniques

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VIII. COURSE OBJECTIVES(COs):

The course should enable the students to:	
I	Analyze the fluid flow through pipes.
II	Understand the external fluid flow.
III	Apply simulation techniques to heat flow problems.
IV	Evaluate the thermal stresses of real time problems.
V	Demonstrate the 3D Heat conduction for real time problems

IX. COURSE OUTCOMES:

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand and apply finite element methods to fluid flow problems	CLO1	Understand basic units of measurement, convert Units, and appreciate their magnitudes.
		CLO2	Understand the basic principles of FEM
		CLO3	Utilize the governing equation for solving the fluid flow through the pipe
CO 2	Understand various types of fluid flow and able to apply basic fundamental equations applied to fluid flow using ANSYS and MATlab	CLO4	Model the 3D pipe flow domain using ANSYS
		CLO5	Mesh the 3D pipe flow domain using ANSYS
		CLO6	Validate the results of analytical models introduced in lecture to the actual behavior of real fluid flows
		CLO7	Plot the variation velocity through the branch of pipes using 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.	CLO8	Learn the creation of geometry using key point
		CLO9	Plot the analysis of external fluid flow problem
		CLO10	Determine the drag coefficient of a circular cylinder
		CLO11	Modeling and assemble of ball valve
		CLO12	Simulation of flow through ball valve
CO 4	Analyze heat transfer coefficient on different surfaces, components and design of heat exchanging equipment.	CLO13	Plot the temperature distribution through the solid using ANSYS APDL
		CLO14	Plot the vector distribution of thermal gradient and thermal flux of solid
		CLO15	Temperature distribution of fin element.
		CLO16	Treatment of boundary conditions.
		CLO17	Plot the 3Dheat conduction distribution.
		CLO18	Calculation of the efficiency of the counter flow Heat exchanger using ANSYS Flow Simulation.
CO5	Understand 3-D thermal analysis and flow simulation using ANSYS.	CLO19	Conjugate heat transfer problem using ANSYS Flow Simulation.
		CLO20	3D Thermal Analysis, Finned Pipe using ANSYS
		CLO21	Thermal stress analysis of piston
		CLO22	Plot the nodal as well elemental distribution of process parameters

X. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME113.01	CLO 1	Understand basic units of measurement, convert Units, and appreciate their magnitudes.	PO 1	2
AME113.02	CLO 2	Understand the basic principles of FEM	PO 1, PO 3	2
AME113.03	CLO 3	Utilize the governing equation for solving the fluid flow through the pipe	PO 1, PO 3	2
AME113.04	CLO 4	Model the 3D pipe flow domain using ANSYS	PO 1, PO 4	2
AME113.05	CLO 5	Mesh the 3D pipe flow domain using ANSYS	PO 1, PO 3	2
AME113.06	CLO 6	Validate the results of analytical models introduced in lecture to the actual behavior of real fluid flows	PO 2	3

AME113.07	CLO 7	Plot the variation velocity through the branch of pipes using Mat lab	PO 2	3
AME113.08	CLO 8	Learn the creation of geometry using key point	PO 2	3
AME113.09	CLO 9	Plot the analysis of external fluid flow problem	PO 2	3
AME113.10	CLO 10	Determine the drag coefficient of a circular cylinder	PO 3	2
AME113.11	CLO 11	Modeling and assemble of ball valve	PO 1, PO 3	2
AME113.12	CLO 12	Simulation of flow through ball valve	PO 2	3
AME113.13	CLO 13	Plot the temperature distribution through the solid using ANSYS APDL	PO 1, PO 3	2
AME113.14	CLO 14	Plot the vector distribution of thermal gradient and thermal flux of solid	PO 2	3
AME113.15	CLO 15	Temperature distribution of fin element.	PO 3, PO 4	2
AME113.16	CLO 16	Treatment of boundary conditions.	PO 2	3
AME113.17	CLO 17	Plot the 3Dheat conduction distribution.	PO 2	3
AME113.18	CLO 18	Calculation of the efficiency of the counter flow heat exchanger using ANSYS Flow Simulation.	PO 2	3
AME113.19	CLO 19	Conjugate heat transfer problem using ANSYS Flow Simulation.	PO 3,PO 4	2
AME113.20	CLO 20	3D Thermal Analysis, Finned Pipe using ANSYS	PO 2	3
AME113.21	CLO 21	Thermal stress analysis of piston	PO 3, PO 4,	2
AME113.22	CLO 22	Plot the nodal as well elemental distribution of process parameters	PO 3, PO 4,	2

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				
	PO1	PO2	PO3	PO4	PSO2
CO 1	2		2		2
CO 2	2	3	2	2	2
CO 3	2	3	2		2
CO 4	2	3	2	2	2
CO 5		3	2	2	2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2													2	
CLO 2	2		2												
CLO 3	2		2											2	
CLO 4	2			2										2	
CLO 5	2		2											2	
CLO 6		3												2	
CLO 7		3													

CLO 8		3											2	
CLO 9		3											2	
CLO 10			2											
CLO 11	2		2										2	
CLO 12		3												
CLO 13	2		2										2	
CLO 14		3												
CLO 15			2	2									2	
CLO 16		3												
CLO 17		3												
CLO 18		3											2	
CLO 19			2	2									2	
CLO 20		3											2	
CLO 21			2	2									2	
CLO 22			2	2									2	

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XIII. ASSESSMENTMETHODOLOGIES–DIRECT

CIE Exams	PO 1, PO2 PO 3, PO4,	SEE Exams	PO 1, PO2 PO 3, PO4,	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO2 PO 3, PO4	Student Viva	PO 1, PO 2 PO 3, PO 4	Mini Project	-	Certification	-

XIV. ASSESSMENTMETHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

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 drag coefficient of a circular cylinder immersed in a uniform fluid stream using ANSYS/Solid Works Flow Simulation.	
Week-5	**FLOW THROUGH BALL VALVE**
Flow of water through a ball valve assembly using ANSYS/ Solid Works 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.	
2. Jaluria,Y.," Design and Optimization of Thermal Systems", McGraw-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., 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.	

XVI. COURSEPLAN:

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

Week No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Internal Pipe flow problem Using theoretical FEM	CLO 1, CLO 2, CLO 3, CLO 6	T1:1.4 R1:1.2
2	Analyzing Flow in a System of Pipes using ANSYS	CLO 1, CLO 2, CLO 3, CLO 6	T2:1.5 R1:2.4
3	Internal Pipe flow problem using MAT LAB	CLO 5, CLO 6, CLO 14, CLO 15,CLO 17	T1:2.5 R1:2.5
4	Thermal Analysis, Plate using ANSYS.	CLO 4, CLO 6	T1:2.5 R1:2.6
5	Flow of water through a ball valve assembly usingANSYS/ SolidWorks Flow Simulation.	CLO 12, CLO 6	T2:22.7
6	Heat Conduction within a Solid using ANSYS	CLO 7, CLO 10, CLO 18, CLO 21	T1:6.3 R1:5.3
7	Temperature distribution in a fin cooled electronicComponent using ANSYS.	CLO 7, CLO 10, CLO 18, CLO 21	T1:7.5 R2:6.3
8	3D Heat Conduction within a Solid-Cell Phone using ANSYS	CLO 7, CLO 10, CLO 18, CLO 21	T1:8.5 R1:6.8

9	Calculation of the efficiency of the counter flow heat exchanger using ANSYS/SolidWorks FlowSimulation	CLO 8, CLO 9, CLO 19	T1:12.2 R1:13.1
10	Conjugate heat transfer problem using ANSYS/ Solid Works Flow Simulation	CLO 8, CLO 9, CLO 19	T1:12.3 R1:13.2
11	3d thermal analysis	CLO 8, CLO 9, CLO 19	T1:12.10 R2:13.7
12	Thermal stress analysis	CLO 11,CLO 13, CLO 16, CLO 20, CLO 22	T2:11.2 R3:10.2

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

S NO	Description	Proposed actions	Relevancewith POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Compare analysisand testingresults	PO 1, PO 4	PSO 2
2	Encourage students to solve real timeapplications and prepare towards industrial needs.	NPTEL	PO 2	PSO2

Prepared by:

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