UES011 THERMO-FLUIDS*

L	T	P	Cr
3	1	2	4.5

Course Objective
To understand basic concepts of fluid flow and thermodynamics and their applications in solving engineering problems.

Fluid Mechanics

- **Introduction**: Definition of a fluid and its properties
- **Hydrostatics**: Measurement of pressure, thrust on submerged surfaces
- **Principles of Fluid Motion**: Description of fluid flow, continuity equation, Euler and Bernoulli equations, Pitot total head and static tubes, venturi-meter, orifice-meter, rotameter, momentum equation and its applications
- **Pipe Flow**: Fully developed flow, laminar pipe flow, turbulent pipe flow, major and minor losses,hydraulic gradient line (HGL) and total energy line (TEL)
- **Boundary Layer**: Boundary layer profile, displacement, momentum and energy thickness

Thermodynamics

- **Introduction**: Properties of matter, the state postulate, energy, processes and thermodynamic systems
- **Properties of Pure Substances**: Property tables, property diagrams, Mollier diagram, phase change, equations of state (ideal gas)
- **Energy**: Energy transfer by heat, work and mass
- **First Law of Thermodynamics**: Closed system, open system, steady-flow engineering devices
- **Second Law of Thermodynamics**: Statements of the second law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle, entropy and entropy change.

Laboratory/Project programme

List of Experiments

1. Verification of Bernoulli's theorem
2. Determination of hydrostatic force and its location on a vertically immersed surface
3. Determination of friction factor for pipes of different materials
4. Determination of loss coefficients for various pipe fittings
5. Verification of momentum equation
6. Visualization of laminar and turbulent flow, and rotameter
7. Calibration of a venturi-meter
8. Boundary layer over a flat plate

***Lab to be conducted every alternate week.**

Sample List of Micro-Projects

Students in a group of 4/5 members will be assigned a micro project.

1. Design a physical system to demonstrate the applicability of Bernoulli's equation
2. Determine the pressure distribution around the airfoil body with the help of wind tunnel
3. Demonstrate the first law of thermodynamics for an open system, for example: a ordinary hair dryer
4. Develop a computer program for solving pipe flow network

Course Learning Outcomes (CLO):

Upon completion of this course, the students will be able to:

1. Analyze and solve problems of simple fluid based engineering systems including pressures and forces on submerged surfaces
2. Analyze fluid flow problems with the application of the mass, momentum and energy equations
3. Evaluate practical problems associated with pipe flow systems
4. Conceptualize and describe practical flow systems such as boundary layers and their importance in engineering analysis
5. Estimate vapor-liquid properties and solve basic problems using steam tables, Mollier diagrams and equation of state
6. Analyze and solve problems related to closed systems and steady-flow devices by applying the conservation of energy principle
7. Analyze the second law of thermodynamics for various systems and to evaluate the performance of heat engines, refrigerators and heat pumps

Text Books:

1. *Kumar, D. S, Fluid Mechanics and Fluid Power Engineering, S. K. Kataria (2009).*
2. *Cengel and Boles, Thermodynamics: an Engineering Approach, McGraw-Hill (2011).*

Reference Books:

1. *Jain, A. K. , Fluid Mechanics: including Hydraulic Machines, Khanna Publishers (2003).*
2. *Rao, Y.V. C, An Introduction to Thermodynamics, Universities Press (2004).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional (may be tutorials/ quizzes/ assignments/lab/ project)	35