

Fluid Mechanics
T.E. Sem. V [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	02(PE)	25
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. Fluid Definition and Properties

Concept of continuum, Newton's law of viscosity, classification of fluid.

Fluid Statics

Definition of body forces and surface forces, static pressure, Pascal's law, Derivation of basic hydrostatic equation, Forces on surfaces due to hydrostatic pressure, Buoyancy and Archimedes Principle.

2. Fluid Kinematics

Understanding of Eulerian and Lagrangian– approach to solutions, Velocity and acceleration in an Eulerian flow field, Definition of streamlines, path lines and streak lines. Definition of steady / unsteady, uniform / non–uniform, one two and three–dimensional flows. Understanding of differential and integral methods of analysis. Definition of a control volume and control surface, types of control volumes.

3. Fluid Dynamics

Equations for the control volume : Integral equations for the control volume; Reynolds transport theorem with proof. Application to mass, energy and momentum transport (linear and angular). Differential equations of the control volume: Conservation of mass (two and three dimensional). Navier – Stokes equations (without proof) for rectangular and cylindrical co–ordinates. Exact solution of Navier – stokes equations: viscous laminar flow of a fluid through a pipe, viscous laminar flow of a fluid through planes (both stationary, one plane moving with a uniform velocity), Fluid flow through concentric cylinders. Euler's equations in two, three dimensions; Bernoulli's equation. Kinetic energy correction factor and momentum energy correction factor.

4. Ideal Fluid Flow Theory

Definition of stream functions and velocity potential functions, rotational and irrotational flows in two dimensions, definition of source, sink, vortex, circulation. Combination of simple flow patterns– e.g. flow past Rankine full body and Rankine half body, Doublet, flow past cylinder with and without circulation, Kutta – Joukowski law.

Real Fluid Flows

Definition of Reynolds number, Turbulence and theories of turbulence – Prandtl's mixing length theory, Eddy viscosity theory, k – epsilon theory. Velocity profiles for turbulent flows: one – seventh power law, universal velocity profile, velocity profiles for smooth and rough pipes, Darcy's equation for head lost in pipe flows, pipes in series and parallel, hydraulic gradient line, Moody's diagram.

5. Boundary Layer Flows

Concept of boundary layer and definition of boundary layer thickness, displacement thickness, momentum thickness, energy thickness. Growth of boundary layer, laminar and turbulent boundary

layers, laminar sub-layer, Von-Karman momentum integral equations for the boundary layers, analysis of laminar and turbulent boundary layers, calculation of drag., separation of the boundary layer and methods to control it, concept of streamlined and bluff bodies. Aerofoil theory: definition of an aerofoil, lift and drag on aerofoils, induced drag.

6. Introduction to Computational Fluid Dynamics

Basic concepts, Basic aspects of discretization. Grids with appropriate transformation, some simple CFD techniques. Finite volume method of analysis, solutions to simple flow problems. Numerical solution by means of an implicit method and pressure correction method.

References :

1. Fluid Mechanics (*Streeter and Wylie*) McGraw Hill
2. Mechanics of Fluid 3rd edition (*Merle Potter, David Wiggert*) Cengage Learning
3. Fundamental of Fluid Mechanics 5th edition (*Munson*) Wiley
4. Fluid Mechanics (*Frank M. White*) McGraw Hill
5. Fluid Mechanics (*Cengel, Yunus, Bhattacharya, Souvik*) McGraw Hill
6. Fluid Mechanics (*K.L. Kumar*)
7. Introduction to Computational Fluid Dynamics (*Niyogi*) Pearson Education
8. An Introduction to Computational Fluid Dynamics The Finite Volume Method 2nd edition (*Versteeg*) Pearson Education
9. Introduction to Fluid Mechanics 5th edition (*Fox*) Wiley
10. Introduction to Fluid Mechanics, (*Shaughnessy*) et al, Oxford
11. Introduction to Fluid Mechanics and Fluid Machines 2nd ed., Tata McGraw Hill
12. Fluid Mechanics (*Yunus Cengel and John Cimbala*) Tata McGraw Hill.
13. Advanced Fluid Dynamics (*Muralidhar and Biswas*)
14. Fluid Mechanics (*Douglas*) et.al. 5th, Pearson Education
15. Computational Fluid Dynamics (*John Anderson*) McGraw Hill
16. Fluid Mechanics with Engineering Applications (*John Finnemore, Joseph Franzini*) McGraw Hill
17. 1000 Solved Problems in Fluid Mechanics (*K. Subramanya*) Tata McGraw Hill

