FLUID MECHANICS II

ENGINEERING 6961

Course Content [# lectures]

Compressible Flows: [6] This section starts with a discussion of compressible flow phenomena. It then derives the thermo/fluid equations governing these flows. Applications include: unsteady flows in pipes; high pressure gas flows in pipes; choked flow in nozzles; shock waves; expansion waves.

Conservation Laws: [2] This section outlines the derivation of the conservation laws for a general fluid flow. The partial differential equations or PDEs that result from the derivation are constraints that must be satisfied at every point in a flow.

Boundary Layer Flows: [1] This section starts with a discussion of boundary layer flow phenomena. Laminar and turbulent boundary layers are described. A special set of partial differential equations for boundary layers is developed.

Turbulent Flows: [1] This section starts with a discussion of turbulent flow phenomena. It introduces the eddy viscosity concept and outlines the derivation of a set of partial differential equations for this viscosity. The derivation of a modified form of the conservation laws for turbulent flows is outlined.

Computational Fluid Dynamics: [2] This section describes how approximate solutions to practical problems can be obtained using Computational Fluid Dynamics or CFD. Details of the CFD approximations are given. Applications are given for turbulent hydrodynamics flows and other complex flows.

Potential Flows: [6] This section deals with inertia dominated flows with zero viscosity. Starting with the partial differential equations for a general flow, it derives a special set of partial differential equations for these flows. Applications include: pollution dispersion and loads on bodies.

Low RE Flows: [4] This section deals with viscosity dominated flows with zero inertia. Applications include: lubrication bearings and porous media flow.

Learning Outcomes

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

1. Understand how pressure waves propagate in pipe networks.
2. Calculate pressure and flow transients in pipe networks.
3. Understand gas dynamic choking at pipe constrictions.
4. Understand shock and expansion waves in supersonic flows.
5. Apply compressible flow theory to steady flows in pipes.
6. State the conservation laws for a point in a general fluid flow.
7. Understand the influence of boundary layers on fluid flow.
8. Understand the influence of turbulence on fluid flow.
9. Understand the eddy viscosity concept for turbulent flow.
10. Use computational fluid dynamics to solve fluid flow problems.
11. Understand the approximations made for potential flows.
12. Apply potential flow theory to pollution dispersion.
13. Apply potential flow theory to loads on bodies.
14. Understand the approximations made for low re flows.
15. Apply creeping flow theory to porous media flows.
16. Apply creeping flow theory to lubrication bearings.
17. Understand the basics of two phase flows.
18. Understand the basics of fluid structure interaction.