MOMENTUM TRANSFER

Course Code: 22CH1102

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Course Outcomes: At the end of the course the student shall be able to
CO1: describe static and dynamic behavior of fluids.(L2)
CO2: illustrate incompressible flow in pipes and channels. (L3)
CO3: analyze compressible fluids. (L4)
CO4: explain flow past immersed bodies and two phase flow. (L2)
CO5: select different equipment for transportation and metering of fluids. (L4)

UNIT-I **10 Lectures**

Unit operations, unit systems, Dimensional analysis: Buckingham π Theorem and Rayleigh's method., basic concepts, Fluid statics and its applications-hydrostatic equilibrium, applications of fluid statics. Fluid flow phenomena - laminar flow, shear rate, shear stress, rheological properties of fluids, turbulence, boundary layers,

Learning outcomes: After the completion of the Unit I, the student will be able to
1. Explain the principles of static and dynamic behavior of fluids. (L2)
2. identify types of flow regimes. (L1)
3. enumerate the rheological properties of fluids. (L1)

UNIT-II **10 Lectures**

Basic equations of fluid flow – mass balance in a flowing fluid, differential momentum balance and mechanical energy equations. Incompressible flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

Learning outcomes: After the completion of the Unit II, the student will be able to
1. describe basic equations for fluid flow. (L2)
2. apply Bernoulli's theorem for fluid flow problems. (L3)
3. calculate friction factor for different types of flow through pipes and fittings. (L3)

UNIT-III **10 Lectures**

Flow of compressible fluids - definitions and basic equations, processes of compressible flow, isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

Learning outcomes: After the completion of the Unit III, the student will be able to
1. identify compressible flow processes. (L1)
2. calculate parameters of the processes. (L3)
3. analyze compressible flow of fluids. (L4)

UNIT-IV **10 Lectures**

Flow past immersed bodies, drag and drag coefficient, flow through bed of solids, motion of particles through fluids, fluidization. Two phase flow: Applications of Gas- Liquid, Gas-Solid, Solid-Liquid flows in Chemical engineering.

Learning outcomes: After the completion of the Unit IV, the student will be able to
1. list the applications of packed and fluidized beds in process industries. (L1)
2. calculate pressure drops through packed and fluidized beds. (L3)
3. classify different types of fluidization. (L4)

UNIT-V **10 Lectures**

Transportation and metering of fluids- pipes, fittings and valves, pumps: positive displacement pumps and centrifugal pumps. Fans, blowers, and compressors, measurement of flowing fluids- full bore meters, insertion meters.

Learning outcomes: After the completion of the Unit V, the student will be able to

1. select suitable fittings and valves for a given flow problem.(L5)
2. compare different fluid moving machinery.(L5)
3. identify flow measuring devices such as head and area meters.(L1)

Text Book:

McCabe W.L., Smith J.C. and Harriot P., *Unit Operations of Chemical Engineering*, 7th Edition, McGraw-Hill, 2005.

References:

1. James O Wilkes, *Fluid Mechanics for Chemical Engineers*, 2nd Edition, Prentice Hall, New Jersey, 2006.
2. De Nevers, N., *Fluid Mechanics for Chemical Engineers*, 3rd Edition, McGraw Hill, 2005.
3. Christie J. Geankoplis, *Transport processes and unit operations*,4th Edition, PHI.
4. Coulson and Richardson,*Chemical Engineering, Vol-I*, Pergamon Press,6th edition, 1999