UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Lecture-wise Plan

Subject Fluid mechanics & Fluid Machines **Subject Code-MEC407T**
Year: 2nd Year **Semester: Forth**

Module Number	Topics	Number of Lectures
1	**1. Introduction to Fluid Mechanics**	**12L**
	Review of fluid properties and fluid statics	**2**
	Viscosity-dynamic and kinematic	**1**
	Surface Tension. Fluid Statics: Basic equation of fluid statics	**2**
	Manometers	2
	Hydraulic forces on submerged surfaces; forces on vertical,horizontal surfaces	1
	Hydraulic forces on inclined and curved surfaces	2
	Buoyant force, Stability of floating and Submerged bodies.	2
2	**2. Kinematics of fluid flow:**	**3L**
	fluid flow and classifications. Continuity equation in 1-D	1
	Continuity equation in 3-D	1
	Potential flow & Stream function; types of flow lines	1
3	**3. Dynamics of fluid:**	**4L**
	Equations of motion; Euler's equation;	1
	Bernoulli's equation; Applications of Bernoulli's	2
	Problems on Bernoulli's equation	1
4	**4. Momentum Analysis of flow systems;**	**4L**
	The linear momentum equation for steady flow	1
	The linear momentum equation for steady flow (differential approach)	2
	Problems	1
5	**5. Flow through pipes;**	**4L**
	Darcy – Weisbach equation of friction loss;	1
	Hydraulic grade line and total energy line	2
	Problems	1
6	**6. Basic principle for flow through orifices;**	**4L**
	Derivation of discharge through V-notches	1
	Derivation of discharge through weirs (rectangular)	1
	Flow through open channels; use of Chezy's formula	1
	Problems	1
7	**7. Dimensional Analysis & Model investigation applied to flow systems**	**4L**
	Introduction to dimensional analysis and its applications	1
	Buckingham Pi theorem.	1
	Dimensionless numbers in fluid flow	1
	Problems	1
8	**8. Application of fluid;**	**4L**

	Hydraulic press, Hydraulic accumulator	1
	Hydraulic Ram, Hydraulic lift,	1
	Hydraulic coupling, Hydraulic torque convertor	1
	Gear pump	1
09	**09. Hydraulic Turbines;**	**6L**
	Introduction of Hydraulic Turbine and Classifications	1
	Introduction of Pelton Wheel, Francis Turbine, Kaplan Turbine	1
	Function of Draft Tube	1
Total Number Of Hours = 42		

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Lecture-wise Plan

Assignments 1

1. Define fluid with examples.
2. Define Ideal Fluid & Real Fluid.
3. Distinguish between Newtonian and non-Newtonian fluids.
4. Define the term centre of pressure of the plane area immersed in a fluid .Do the Centre of pressure and centre of gravity ever coincide and if so under what conditions?
5. Define the following terms with their units.
   i. Specific weight ii. Specific gravity iii. Surface Tension iv. Dynamic viscosity v. Specific weight or Weight density vi.Specific volume vii.Specific gravity or Relative density viii. Bulk modulus and compressibility
6. How does the dynamic viscosity of (a) liquids and (b) gases vary with temperature?
7. Calculate specific weight, density, specific volume and specific gravity of one liter of liquid which weighs 7.836 N.
8. Calculate dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m 0.8m and an inclined plane with angle of inclination 30 . The weight of square plate is 300 N and is slide down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5mm. [Ans: 11.7 poise]
9. A 50 mm diameter shaft rotates with 500 rpm in a 80 mm long journal bearing with 51 mm internal diameter. The annular space between the shaft and bearing is filled with lubricating oil of dynamic viscosity 1 poise. Determine the torque required and power absorbed to overcome friction.
10. A plate 0.03 mm distant from a fixed plate, moves at 70 cm/s and requires a force of 3 N/m2 to maintain this speed. Calculate the fluid viscosity between the plates.
11. Derive the expression for total pressure and centre of pressure for a vertical plate submerged in the liquid with usual notations.
12. Determine the total pressure and depth of centre of pressure on a plane rectangular surface of 1 m wide and 3 m deep when its upper edge is horizontal and (a) coincides with water surface (b) 2 m below the free water surface.
13. A vertical sluice gate is used to cover an opening in a dam. The opening is 2m wide and 1.2m high. On the upstream side of the gate, the liquid of sp. gr. 1.45, lies up to a height of 1.5 m above the top of the gate, and on the down steam side the water is available up to a height touching the top of the gate. Find the resultant force acting on the gate and position of centre of pressure. Find also the force acting horizontally at the top of the gate which capable of opening it. Assume that the gate is hinged at the bottom.

Assignments 2

1. Derive an expression for continuity equation for three dimensional flow and reduce it for steady, incompressible 2-D flow in Cartesian co-ordinate system.
2. Explain the following in brief:
   a. Total acceleration, Convective acceleration & Local acceleration
   b. Velocity potential function & Stream function c. Vorticity & Circulation
   d. Steam line, Streak line & Path line
3. Prove that equipotential line and stream line are perpendicular to each other. How do you classify cutting tool? Brief them.
5. Define vortex flow. Also derive expressions of potential function and stream function for vortex flow.
6. Differentiate between free and forced vortex flow
7. Explain various types of fluid flow.

Assignments 3

1. Derive Euler's equation of motion along a stream line and hence obtain Bernoulli's equation. Also state Bernoulli's theorem with its assumptions.
2. Explain Venturimeter in brief and Derive an expression for discharge through Venturimeter.
3. What is pitot tube. Derive an expression for the measurement of velocity of flow at any point in a pipe by pitot tube.
4. Derive an expression for discharge over triangular notch.
5. Derive an expression for discharge over rectangular orifice.
6. Define following terms
   I. Kinetic energy correction factor
   II. Momentum energy correction factor
7. The water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 litres/s. The section 1 is 6 m above datum and section 2 is 3 m above datum. If the pressure at section 1 is 29.43 N/cm^2, find the intensity of pressure at section 2.
8. velocity in the duct is 0.85 of the central velocity. Determine the discharge through the duct if the difference between the static and total pressure is 80 mm of water.. In a duct of 400 mm diameter, a pitot static tube is placed in the centre. The mean The co-efficient of pitot tube as $C_V = 0.98$
9. An oil of sp. gr. 0.9 is flow through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 20 cm. Calculate the discharge of oil through the horizontal venturimeter. Take C_d=0.98.
10. An orifice-meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 14.715 N/cm^2 and 9.81N/cm^2 respectively. Find the rate of flow of water through the

pipe in litres/s. Take C_d = 0.6.

Assignments 4

1. What is difference between momentum equation and impulse momentum equation?
2. Define and derive moment of momentum equation.
3. Derive expression for force exerted by flowing fluid on a pipe bend.
4. A 300mm diameter pipe carries water under a head of 20meters with a velocity of 3.5m/s.if the axis of the pipe turns through 45 degree; find the magnitude and direction of the resultant force at the bend.

Assignments 5

1. Derive the expression for Darcy- Weisbach formula for friction loss in the pipe.
2. Explain total energy line (T.E.L) and Hydraulic gradient line (H.G.L).
3. Two reservoirs are connected by a pipeline which is 15 cm in diameter for the first 5 m and 25 cm diameter for the remaining 15 m. Entry to and exit from the pipe is sharp and the water surface in the upper reservoir is 7.5 m above that in the lower reservoir. Represent layout and calculate the head losses and flow rate by assuming the friction co-efficient is 0.01 for both the pipes. Also draw hydraulic gradient line (H.G.L) and Total energy line (T.E.L).

Assignments 6

1. Derive an expression for uniform flow through an open channel by using Chezy's formula.
2. Water flow over a rectangular weir 1m wide at a depth of 150mm and afterwards passes through a triangular right-angled weir. Taking C for the rectangular and triangular weir as 0.62 and 0.59 respectively, find the depth over the rectangular weir.
3.Derive an expression for discharge over triangular or v-notch.

Assignments 7

1. State Buckingham's π-theorem. What do you mean by repeating variables? How the repeating variables are selected in dimensional analysis?
2. State the various dimensionless numbers with their significance in fluid flow situations. Explain Froude, Euler and Weber model law with applications.
3. Discuss different types of similarities that must exist between a prototype and its model.
4. Explain Rayleigh's methods of dimensional analysis.
5. Find an expression for the drag force F on smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density ρ and dynamic viscosity μ.
6. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters.

Assignments 8

1. Explain the components & working of the Francis turbine with the help of a neat sketch.

2. What is the function of draft tube? Explain various types of draft tube.
3. Explain various components & working of Kaplan turbine with the help of a neat sketch.
4. What is Cavitation? What are the effects & precaution of cavitation in hydraulic turbine?