



**SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)**

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QUESTION BANK (DESCRIPTIVE)

Subject with Code: FM & HM (20CE0160)

Course & Branch: B.Tech - ME

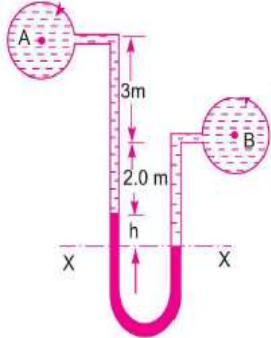
Regulation: R20

Year & Sem: II-B.Tech & I-Sem

UNIT –I

FLUID PROPERTIES & FLUID STATICS

1.	a)	Define and mention units for the following fluid properties: Density, specific weight, and specific gravity of a fluid.	[L1][CO1]	[6M]
	b)	Calculate the density, specific weight and weight of one litre of a petrol of specific gravity is 0.7.	[L3][CO1]	[6M]
2.	a)	Differentiate kinematic viscosity and dynamic viscosity. Give their dimensions.	[L4][CO1]	[6M]
	b)	A plate 0.025mm at a distance from a fixed plate moves at 60 cm/sec and requires a force of 2 N/m ² . Determine viscosity between the plates.	[L3][CO1]	[6M]
3.	a)	Define surface tension. Derive the expression for surface tension on liquid droplet.	[L1][CO1]	[8M]
	b)	The surface tension of water in contact with air at 20 ⁰ C is 0.072 N/m. The pressure inside of water droplet of water is to be 0.02 N/cm ² greater than the outside pressure. Calculate the diameter of the droplet of water.	[L3][CO1]	[4M]
4.	a)	Explain the terms of compressibility and bulk modulus.	[L2][CO1]	[6M]
	b)	Obtain an expression for capillary rise of a liquid.	[L2][CO1]	[6M]
5.	a)	Explain the phenomenon of capillarity. Obtain an expression for capillary fall of a liquid	[L2][CO1]	[6M]
	b)	Calculate the capillary raise in a glass tube of 2.5mm diameter when immersed vertically water & mercury. Take surface tension is 0.0725 N/m for water and 0.52 N/m for mercury. The specific gravity of mercury is given 13.6 and angle of contact is 130 ⁰ .	[L3][CO1]	[6M]
6.	a)	State Pascal's law. What do you understand the terms Gauge & Vacuum pressure?	[L1][CO1]	[6M]
	b)	What is the gauge pressure at a point 3m below the free surface of a liquid having a density 1.53 x 10 ³ kg/m ³ , if the atmospheric pressure is equivalent to 750 mm of mercury, the Specific gravity of mercury is 13.6 and density of water = 1000 kg/m ³ ?	[L1][CO1]	[6M]
7.		Derive the expression for pressure difference in U-tube differential manometer and Inverted U-tube differential manometer with neat sketches.	[L3][CO1]	[12M]
8.	a)	Discuss the U- tube Manometer in detail and derive the expression for pressure measurement.	[L2][CO1]	[6M]
	b)	A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity is 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is	[L3][CO1]	[6M]

		40cm and the height of fluid in the left from the center of pipe is 15cm below.		
9.	a)	List out different types of manometers. Explain about piezometer in detail.	[L1][CO1]	[6M]
	b)	An inverted U – tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30cm. When an oil of specific gravity 0.8 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted manometer (when measured from the respective center lines of the pipes) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes.	[L3][CO1]	[6M]
10.		<p>A differential manometer is connected at two points A and B of two pipes as shown in the figure. The pipe A contains a liquid of specific gravity 1.5 while pipe B contains a liquid of specific gravity 0.9 pressure at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in Mercury level in a differential manometer.</p> 	[L3][CO1]	[12M]

UNIT –II
FLUID KINEMATICS & FLUID DYNAMICS

1.	a)	Define the terms: Stream line, streak line and path line	[L1][CO2]	[6M]
	b)	Define rate of flow and derive continuity equation for one dimensional flow.	[L1][CO2]	[6M]
2.		Explain different types of flow in detail.	[L2][CO2]	[12M]
3.		Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.	[L3][CO2]	[12M]
4.	a)	A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s.	[L3][CO2]	[8M]
	b)	Derive Continuity equation for three dimensional forms.	[L3][CO2]	[4M]
5.	a)	The diameters of a pipe at the sections 1 & 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Determine also the velocity at section 2.	[L3][CO2]	[6M]
	b)	Define the following terms: Velocity potential function, stream function and flow net.	[L1][CO2]	[6M]
6.		Derive Bernoulli's equation and state assumptions.	[L3][CO2]	[12M]
7.	a)	Define momentum equation and impulse momentum equation.	[L1][CO2]	[4M]
	b)	Water is flowing through a pipe has diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm ² and the pressure at the upper end is 9.81 N/cm ² . Determine the difference in datum head if the rate of flow through pipe is 40 lit/s.	[L3][CO2]	[8M]
8.	a)	Derive equation for force exerted by the flowing fluid on a Pipe bend.	[L3][CO2]	[6M]
	b)	Obtain Euler's equation of motion.	[L3][CO2]	[6M]
9.	a)	Explain Energy gradient line and Hydraulic gradient line.	[L2][CO2]	[4M]
	b)	The water is flowing through a pipe having diameter 20cm and 10cm at section 1 and 2 respectively. The rate of flow through pipe is 35 liters/s. The section 1 is 6 m above the datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm ² , Find the intensity of pressure at section 2.	[L3][CO2]	[8M]
10.	a)	Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm ² (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross section, which is 5m above the datum line.	[L3][CO2]	[4M]
	b)	A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. if the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force at the bend.	[L3][CO2]	[8M]

UNIT –III**FLOW MEASUREMENT & ANALYSIS OF PIPE FLOW**

1.		Explain about Venturimeter with neat sketches. Derive expression for rate of flow through Venturimeter.	[L2][CO3]	[12M]
2.		An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30cm diameter. The pressure difference measured by mercury oil in differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of file of specific gravity 0.9 when the coefficient of discharge of the orifice meter is 0.64.	[L3][CO3]	[12M]
3.		Explain about orifice meter with neat sketches. Derive expression for rate of flow through orifice meter.	[L2][CO3]	[12M]
4.	a)	Illustrate pitot tube and pitot static tube.	[L2][CO3]	[6M]
	b)	A sub-marine move horizontally on a sea and has its axis 15m below the surface of water. A pitot tube properly placed just in front of a sub-marine and along its axis is connected to two limbs of a U – tube containing mercury. The difference of mercury level is found to be 170mm. Find the speed of the sub-marine knowing that the specific gravity of mercury is 13.6 and that of sea water is 1.026 with respect of fresh water.	[L3][CO3]	[6M]
5.		An oil of specific gravity 0.8 is flowing through a Venturi meter having inlet diameter of 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through a horizontal venturimeter. Take $C_d = 0.98$.	[L3][CO3]	[12M]
6.		Derive the expression for head loss in pipes due to friction by using Darcy-Weisbach equation.	[L3][CO3]	[12M]
7.		List out minor losses in pipe flow and write the equations for all minor losses.	[L1][CO3]	[12M]
8.	a)	Recall the concept of pipes in series and parallel.	[L1][CO3]	[6M]
	b)	Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using Darcy formula.	[L3][CO3]	[6M]
9.		Derive the expression for head loss in pipes due to sudden enlargement	[L3][CO3]	[12M]
10.		A horizontal pipeline 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. the height of water level in the tank is 8 m above the centre of pipe. Considering all losses of head which occur, determine the rate of flow. Take $f = 0.01$ for both sections of the pipe.	[L3][CO3]	[12M]

UNIT –IV
IMPACT OF JETS & INTRODUCTION TO HYDROELECTRIC POWER PLANT

1.	a)	Derive an expression for the force exerted by a jet of water on an inclined fixed plate in the direction of the jet.	[L3][CO4]	[6M]
	b)	A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the center. Find the force extracted by Jet of water in the direction of the jet, if the jet is deflected through an angle of 120° at the outlet of the curved plate.	[L3][CO4]	[6M]
2.	a)	Obtain an expression for the hydraulic efficiency when a liquid jet strikes a single fixed curved vane	[L3][CO4]	[6M]
	b)	A jet of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet 5 m/s. Find the force on the plate, work done and efficiency of jet.	[L3][CO4]	[6M]
3.		Derive an expression for the hydraulic efficiency when a liquid jet strikes an unsymmetrical moving curved plate when jet strikes tangentially at one of the tip.	[L3][CO4]	[12M]
4.	a)	Determine the expression for force and the efficiency by the jet when it strikes at the centre of moving curved plate?	[L3][CO4]	[6M]
	b)	A 7.5 cm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Calculate the normal pressure on the plate when (i) the plate is stationary, and (ii) when the plate is moving with a velocity of 15 m/s and away from the jet.	[L3][CO4]	[6M]
5.		A jet of water of diameter 50mm moving with a velocity of 25 m/s impinges on a fixed curved plate tangentially at one end at an angle of 30° to the horizontal. Calculate the resultant force of the jet on the plate if the jet is reflected through an angle of 50° . Take $g = 10 \text{ m/s}^2$	[L3][CO4]	[12M]
6.		A jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20 m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 90° to the direction of the motion of the vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock.	[L4][CO4]	[12M]
7.		A jet of water moving at 12 m/s impinges on vane shaped to deflect the jet through 120° when stationary. If the vane is moving at 5 m/s, find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	[L1][CO4]	[12M]
8.		A jet of water having a velocity of 15 m/s, strikes a curved vane which is moving with a velocity of 5 m/s in the same direction as that of the jet at inlet. The vane is so shaped that the jet is deflected through 135° . The diameter of jet is 100 mm. Assuming the vane to be smooth, find: (i) force exerted by the jet on the vane in the direction of the motion, (ii) Power exerted on the vane, and (iii) Efficiency of the vane.	[L4][CO4]	[12M]
9.		Explain the various elements of hydroelectric power station with a neat sketch	[L2][CO4]	[12M]
10.	a)	Describe the different types of hydroelectric power stations.	[L1][CO4]	[6M]

	b)	Discuss the factors to be considered for selection of site for hydroelectric power plant.	[L2][CO4]	[6M]
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UNIT –V**HYDRAULIC TURBINES & CENTRIFUGAL PUMPS**

1.		Explain the working principle of a Pelton wheel with a neat sketch and also derive equation for hydraulic efficiency.	[L2][CO5]	[12M]
2.		What is the working principle and design specifications of a Kaplan turbine? Explain.	[L1][CO5]	[12M]
3.		A Pelton wheel is to be designed for the following specifications: Shaft power = 11,772 kW, head = 380 m, speed = 750 r.p.m, overall efficiency = 86%. Jet diameter is not to exceed one-sixth of the wheel diameter. Determine: (i) The wheel diameter, (ii) The number of jets required and (iii) Diameter of jet. Take $K_{v1} = 0.985$ and $K_{u1} = 0.45$.	[L3][CO5]	[12M]
4.		The following data is given for the Francis turbine. Net head $H = 60$ m, Speed $N = 700$ r.p.m., Shaft Power = 294.3 kW, $\eta_o = 84\%$ $\eta_h = 93\%$, flow ratio = 0.2, breadth ratio $n = 0.1$, outer diameter of the runner = 2 X inner diameter of the runner. The thickness of vane occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radially at outlet. Determine: (i) Guide blade angle, (ii) Runner vane angles at inlet and outlet, (iii) Diameters of runner at inlet and outlet, and (iv) Width of wheel at inlet.	[L3]CO5	[12M]
5.		Explain the Classifications and efficiencies of turbines in detail.	[L2][CO5]	[12M]
6.		What is the principle behind a centrifugal pump and derive an expression for work done by the centrifugal pump.	[L1][CO5]	[12M]
7.		Explain Definitions of Heads and Efficiencies of a centrifugal pump.	[L2][CO5]	[12M]
8.	a)	The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.	[L3][CO5]	[8M]
	b)	What is priming process?	[L1][CO5]	[4M]
9.	a)	A centrifugal pump delivers water against a net head of 14.5m and a design speed of 1000 r.p.m. The vanes of curved back to an angle of 30° with the periphery. The impeller diameter is 300mm and outlet width is 50mm. Determine the discharge of the pump if manometric efficiency is 95%.	[L3][CO5]	[7M]
	b)	Describe pumps in series and parallel.	[L2][CO5]	[5M]
10.	a)	Summarize a note on net positive suction head (NPSH).	[L2][CO5]	[6M]
	b)	Derive the expression for specific speed.	[L2][CO5]	[6M]