CIVIL ENGINEERING

QUESTION BANK

Course Title : FLUID MECHANICS

Course Code : CE2104PC

Regulation : NR23

Course Objectives:

- To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
- To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
- To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
- To imbibe basic laws and equations used for analysis of static and dynamic fluids.
- To inculcate the importance of fluid flow measurement and its applications in Industries.
- To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

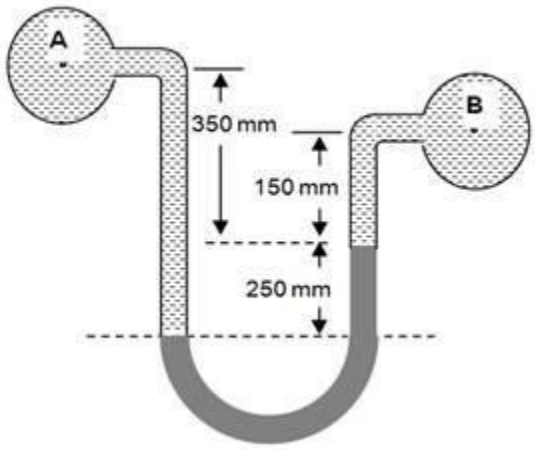
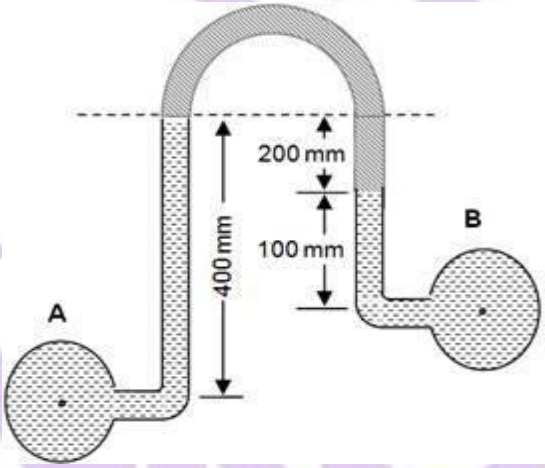
Course Outcomes (CO's):

CO.NO	COURSE OUTCOMES
C01	Understand the fundamental physical properties of fluid and analyze the manometric applications of pressure measurements
C02	Analyze and examine the classification of flows in a kinematics of a fluid
C03	Derive Euler's and Bernoulli's equation and analyze the measurements of discharge
C04	Study the characteristics of flows and examine the energy losses in pipe

UNIT–I

UNIT NAME: Properties of Fluids

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Define the viscosity with necessary formulae	1	1	1
2		Define mass density, specific weight	1	1	1
3		Define Buoyancy	1	1	1
4		Name the devices that are used to measure the pressure of a fluid	2	1	1
5		Write down the expression for capillary fall in terms of surface tension for mercury		1	1
6		Write down formulae for centre of pressure and total pressure force.	4	1	1
7		Define metacenter and meta centric height	1	1	1
8		Compare the difference between solid state and liquid state	4	1	1
9		Define center of pressure and total pressure force	1	1	1
10		Explain the terms of surface tension and vapor pressure	2	1	1
Part – B (Long Answer Questions)					
11	a)	Calculate the capillary rise in a glass tube of 2.5mm diameter when immersed vertically in water and mercury. Take the surface tension 0.07N/m for water and 0.52N/m for mercury.in contact with air, the specific gravity for mercury is 13.6 and angle of contact is 130^0	5	1	3
	b)	Derive an expression for capillarity rise of the liquid	3	1	2
12	a)	Calculate the dynamic viscosity of an oil, which is used to for lubrication between a square plate of size 0.8m ×0.8m and an inclined plane with an angle of inclination 30^0 .The weight of the square plate is 300N and its slides down the inclined plane with a uniform velocity of 0.3m/s. the thickness of the oil film is 1.5mm		1	3
	b)	Define kinematic viscosity in terms of stokes.	1	1	1
13	a)	Derive an expression for total pressure force and center of pressure when a body is immersed vertically in to containing water in the container	3	1	2
	b)	Determine the total pressure force on a circular plane of 1.5 diameter which is placed vertically in water in such way that center of plane is 3m below the free water surface. Find the position of center of pressure also	3	1	2
14	a)	The space between two square flat parallel plates is filled with oil. Each side of the plate is 60cms.the thickness of the oil film is 12.5mm.the upper plate which moves at 2.5m/sec requires a force of 98.1N to maintain the speed. Determine i) dynamic viscosity of the oil in poise ii) if kinematic viscosity of the oil in stokes, if specific gravity of the oil is 0.95	5	1	3
	b)	What is manometer? state its different types of manometers with the neat sketches	2	1	1
15	a)	A U-tube differential manometer is connected to two pipes at A and B. Pipe A Contains oil of Specific Gravity 0.92 and pipe B is carrying water. If the pressure at point A is 125 kN/m^2 find the pressure at point B.	5	1	3

					
16	a)	An inverted tube differential manometer having an oil of specific gravity 0.9 is connected to two different pipes carrying water under pressure. Determine the pressure in the pipe B. The pressure in pipe A is 2 m of water. 	5	1	3

UNIT–II

UNIT NAME: Fluid Kinematics

S.No	Questions	BT	CO	PO
	Part – A (Short Answer Questions)			
1	Define path line and stream line	1	2	1
2	Define and state the applications of momentum equation	1	2	1
3	State the assumptions and Bernoulli's equation for flow along a stream line	2	2	1
4	Classify the types of fluid flows	2	2	1
5	State the continuity equation with assumptions		2	1
6	Define stream function and streak line	1	2	1
7	Define velocity potential	1	2	1

8		Define steady flow, compressible flow and rotational flow	1	2	1
9		Define one ,two and three dimensional flows	1	2	1
10		Define laminar flow, turbulent and transition flows	1	2	1
Part – B (Long Answer Questions)					
11	a)	Derive an expression for an Euler's equation	3	2	2
12	a)	Derive an expression for a Bernoulli's equation and what are assumptions for the application.	3	2	2
13	a)	The water is flowing through a pipe having a diameter 20cm and 10cm at the section 1 and 2 respectively. The weight of flow through the pipe is 35m/sec the section 1 is above the datum and 4m above the datum above at section 2. if the pressure at section 1 is 39.24N/m^2 find the intensity o f pressure at section 2.	5	2	3
	b)	Demonstrate different types of correction factor.	2	2	2
14	a)	A stream function is given by $\psi = 3x^2y+(2+t)y^2$. Find the velocity and determine its value at a point defined by position vector $r = 1i+2j-3k$ when t=2	5	2	3
	b)	The velocity potential function for a 2D flow $Ø = x(2y-1)$ at a fine point P(4,5) determine the velocity u= - dØ/dx	5	2	3
15	a)	For the following stream functions. Calculate velocity at a point(1,2) if i) $\psi = 3xy$ ii) $\psi = 3x^2y-y^3$	5	2	3
	b)	What is the irrotational velocity field associated with the potential $Ø=3x^2-3x+3y^2+16t^2+12zt$	2	2	3
16	a)	A pipe of dia 400mm at a velocity of 25m/sec. The pressure at A and B are 29.43N/cm^2 and 22.563 N/cm^2 respectively. While datum head at A and B are 28m and 30m. find the loss of head between A and B	5	2	3
	b)	Define velocity potential and stream function	1	2	1

UNIT–III

UNIT NAME: Flow Measurement in Pipes

S.No		Questions		BT	CO	PO
		Part – A (Short Answer Questions)				
1		Describe the practical applications of Bernoulli's equation	1	2	3	1
2		Define venturimeter	1	1	3	1
3		Define vena contracta	1	1	3	1
4		Define pitot tube	1	1	3	1
5		Write down Bernoulli's equation of real fluids	1	2	3	1
6		Define the terms Nappe and Crest.	1	1	3	1
7		Write down discharge for trapezoidal section of the notch	1	2	3	1
8		What is velocity of approach	1	1	3	1
9		What is end contractions.	1	1	3	1
10		What are classifications of notches	1	1	3	1
		Part – B (Long Answer Questions)				
11	a)	Derive an expression for determining the discharge flowing through the pipe by using venturimeter.	2	3	3	2
	b)	What are practical applications of Bernoulli's equation	1	2	3	1
12	a)	Obtain an expression of the forces exerted when the pipe is bend	3	3	3	2

	b)	A pipe of 300mm dia conveying 0.3m^3/sec of water as a right angled bent in a horizontal plane find the resultant force exerted on the bent. If the pressure at inlet and outlet are 24.525N/cm^2 and 23.544 N/$cm^{2.}$	5	5	3	3
13	a)	Obtain an expression for trapezoidal notch or weir for determination of the discharge	3	3	3	3
	b)	Define the terms Nappe, crest	1	1	3	1
14	a)	A rectangular notch of crest width is 0.4m is used to measure the flow of water in a rectangular channel of 0.6m and 0.45m d. if water level in the channel is 0.225m above the crest weir. Find the discharge in the channel for the notch assume cd as 0.63 and take velocity of approach consideration?	5	5	3	3
	b)	Define velocity of approach?	1	1	3	1
15	a)	An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62N/cm^2 and 9.81N/cm^2 respectively. Coefficient of discharge for the orifice meter is given as 0.6. find the discharge of water through pipe	5	5	3	3
	b)	A horizontal venturi meter with diameter 30cm and 15cm is used to measure the flow of water readings of differential manometer is 20cm of mercury. Determine the rate of flow.	5	5	3	3
16	a)	A weir of 36m long is divided inti 12 equal bays by vertical post is 60cm wide. Determine the discharge over weir if the head over the crest is 1.2m and velocity of approach	5	5	3	3
	b)	A discharge of 3000 m^3/sec is to pass over a rectangular weir. The weir is divided into number of openings. Each of span 10m. if velocity of approach is 4m/sec. find the number of openings needed in order the head of water over the crest is not to exceed 2m.	5	5	3	3

UNIT–IV

UNIT NAME: Flow Through the Pipes

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Explain about Darcy's Weisbach equation with necessary data	1	4	1
2		What is meant by energy loss in a pipe?	1	4	1
3		What is compound pipe or pipe in series?	1	4	1
4		What is mean by parallel pipe and write down governing equation	1	4	1
5		Define equivalent pipe and write the equation to obtain equivalent pipe diameter	1	4	1
6		What do you understand by the terms a) minor losses b) major losses	1	4	1
7		What are the basic educations to solve the problems in flow through the branched pipes	2	4	1
8		Mention the general characteristics of laminar flow	2	4	1
9		Define Reynolds number with governing equation	1	4	1
10		Give an expression for the for loss of head due to the obstruction in the pipe flow	2	4	1
Part – B (Long Answer Questions)					
11	a)	Derive an expression for the Darcy's weisbach equation	3	4	2

	b)	Find the loss of head when a pipe of dia 200mm is suddenly enlarged to 400mm. The rate of flow of water through the pipe is 250 L/sec	1	4	3
12	a)	The difference in water surface level in two tank which are connected by three pipes in series of lenth:300m,170m,210m and of diameter 300mm,200mm and 400mm respectively is	5	4	3
		12m.Determine the rate of flow if coefficient of friction are 0.005,0.0052,0.0048 respectively. Considering minor loses and major losses			
13	a)	The main pipe is divides into two parallel pipes which again forms as one pipe the length and diameters for first parallel pipe are 2000m and 1m respectively. While the length and diameter of 2nd parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe if rate of flow in the main is 3 m^3 /sec but coefficient of friction of each parallel pipe is same as 0.005	5	4	3
	b)	Define parallel pipes with necessary data	1	4	1
14	a)	Three reservoirs A, B and C are connected by pipe system. Find the discharge from the reservoir B and C. If rate of flow from the reservoir A is 60 l/sec.Find the height of water level in the reservoir and f=0.006	5	4	3
15	a)	Diagram shows three pipes connected in parallel conveying a total discharge of 4.5 cumec. Calculate the discharge through each pipe having the lengths of L1=1800m, L2=1500m,L3=1900m, diameters are 1.25m,1.0m and 1.4m having friction 0.006,0.006 and 0.008 Q1 Q Q Q2 Q3	5	4	3
16	a)	A pipe diameter 300mm and length 3500m is used for the transmission of power by water. The total head at the inlet of the pipe is 500m.Find the maximum power available at the outlet of the pipe, if the value of f=0.006 and maximum efficiency of transmission of power	5	4	3
	b)	What is water hammer and its control measures	2	4	1

UNIT–V

UNIT NAME: Boundary Layer Theory.

S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	What is boundary layer and boundary layer theory?	1	5	01
2	What is momentum thickness?	1	5	1
3	What is magnus effect?	1	5	1
4	What is Displacement thickness?	2	5	1
5	Explain the terms Drag and Lift	2	5	1

6		What is Energy thickness?	2		1
7		Explain in about laminar boundary layer	2	5	1
8		What are factors affecting boundary layer thickness along a smooth plate	2	5	1
9		Mention the methods to control or prevent the boundary layer separation	2	5	1
10		What is boundary layer separation?	2	5	1
Part – B (Long Answer Questions)					
11	a)	Explain in detail about characteristics of a boundary layer along with thin plate and factors affecting boundary layer thickness.	2	5	2
12	a)	Explain in detail about boundary layer thickness and its types in terms of mathematical expression	2	5	2
13	a)	Derive an expression for displacement thickness and momentum thickness	3	5	2
14	a)	Find the displacement thickness and momentum thickness and energy thickness for the velocity distribution in the boundary layer by u/U-y/ δ. when u is the velocity at a distance Y from the plate and u=U at y= δ. Where δ is boundary layer thickness, also calculate the value of δ^*/θ	5	5	3
15	a)	Define Drag and Magnus effect	1	5	1
	b)	A submarine which may be supposed to approximate a cylinder 4m in diameter and 20m long travels submerged at 1.3m/s in sea water. Find the drag exerted on it, if the drag coefficient for Reynolds number greater than 10^5 may be taken as 0.75. The density of sea water is given as 1035kg/m^3 and kinematic viscosity is as 0.15 stokes	5	5	3
16	a)	The air is flowing over a cylinder of diameter 50mm and infinite length with a velocity of 0.1m/sec.Find the total drag; shear drag and pressure drag on 1m length of the cylinder if the total drag coefficient is equal to 1.5 and shear drag coefficient is equal to 0.2. take density of air =1.25kg/cm^3	5	5	3

* **Blooms Taxonomy Level (BT)** (L1 – Remembering; L2 – Understanding; L3 – Applying; L4 – Analyzing; L5 – Evaluating; L6 – Creating)

Course Outcomes (CO)

Program Outcomes (PO)

Prepared By: S Baliram

LEARNING METHODOLOGIES

ASSIGNMENT QUESTIONS-I

1. Write about velocity potential function

2. A stream function is given by $\Psi=8x^2- 5xy^3$. Calculate the velocity components and also magnitude of resultant velocity at any point

3. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp.gravity 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 40cm and the height of fluid in the left from the centre of pipe is 15cm below.

4. Define the following terms
    i. a.Total pressure
    ii. b.Centre of pressure
5. Derive expression for total pressure and center of pressure for a vertically immersed surface.
6. Describe in detail the classification of flows given one example for each category
7. Find the velocity and acceleration at a point (1,2,3) after 1 sec, for a three-dimensional flow given
    a. by u=yv=xz , w=xy
8. Define the following terms & write its units
    i. Mass density b) Weight Density
    ii. Specific gravity d) viscosity e) Kinematic viscosity
9. What is Fluid Dynamics? Derive Euler's equation of motion.

10. What is a Venturimeter? Derive the expression for rate of flow through the venturi meter.

11. a) What is a Manometer? What are the different types of Manometers explain with diagrams
    a. b)A single column manometer is connected to a pipe containing a liquid of sp.gr 0.9. Find the pressure

12. Obtain Von Karman momentum integral equation.

13. A smooth flat plate of size 30 cm X 60 cm is placed in a stream of water of uniform velocity 60 cm/sec. Flow takes parallel to the 30 cm length of the plate. If the kinematic viscosity of water is 0.011 stoke, is the boundary layer formed on the plate laminar or turbulent? Determine the shear stress at the trailing edge, maximum boundary layer thickness, mean drag coefficient and the work done by the fluid on on side of the plate per unit time in Joules.

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15. Explain minor and major losses in pipes. Obtain general formulae for loss determination.

16. Define the momentum of momentum equation. What is the difference between momentum equation
and impulse momentum equation?

17. A pipe of dia 400 mm carries water at a velocity of 25 m/s. The pressures at a point are given as 29.43 N/cm 2and 22.563N/cm2 .while the datum head at A and B are 28 m and 30 m. Find the loss
of head between A and B.

18. A 600 triangular notch with a coefficient of discharge of 0.59 is placed at the downstream end of a channel carrying 0.02m3 /s of water. What will be the height above the base of notch?

19. Write briefly about hydraulic gradient line and total energy line

Quiz

1. If ψ=x2-y2 is the stream function in a 2-D flow field, then the magnitude of the velocity vector at point (1,1) Would be_____
2. A steady irrotational flow of an incompressible fluid is called_____
3. In a free vortex motion, the radial component of velocity everywhere is_____
4. The flow of water through the hole in the bottom of a wash basin is an example of_____
5. Bernoulli's theorem deals with the conservation of_____
6. The force per unit area is called as_____
7. 1 Torr is equal to_____
8. The father of fluid mechanics is _____
9. The wings of aero plane is designed by which of the following principle_____
10. The study of force which produces fluid motion is called as_____
11. The Fluid mechanics is working on the _____law
12. _____causes the turbulence in flowing fluid.
13. The Pascal law is valid for ideal fluid and real fluid at_____condition.
14. The Centre of pressure for a triangle with base on free liquid surface is_____
15. The father of fluid mechanics is_____.
16. The distance between G and metacentric M of the floating body, is called as_____
17. The Centre of gravity of the volume of a liquid is displaced is called_____
18. What is the formula for absolute pressure? _____
19. Bulk modulus is the ratio of_____
20. _____property of the fluid offers resistance to deformation under the action of shear force?

Choose the correct Answers:

1.	What is fluid mechanics?	[ ]
	(a) Study of fluid behavior at rest (b) Study of fluid behavior in motion (c) Study of fluid behavior at rest and in motion (d) Study of solid behavior	
2.	Which of the following is the basic principle of fluid mechanics?	[ ]
	(a) Momentum principle (b) Energy equation (c) Continuity equation (d) All of the above	
3.	Which of the following method is used exclusively in fluid mechanics?	[ ]
	(a) Eulerian Method (b) Control volume analysis (c) Langragian method (d) None of the mentioned	
4.	When is a fluid called turbulent?	[ ]
	(a) High viscosity of fluid (b) >2000 (c) <2000 (d) The density of the fluid is low	
5.	When a fluid is subjected to resistance, it undergoes a volumetric change due to	[ ]
	(a) Cohesion (b) Strain (c) Compressibility (d) None of the above	
6.	Which of the following is a type of fluid based on viscosity?	[ ]
	(a) Real Fluid (b) Ideal Fluid (c) Newtonian Fluid (d) All the above	
7.	The flow in which conditions do not change with time at any point is known as	[ ]
	(a) 1-D flow (b) streamline flow (c) steady flow (d) uniform flow	
8.	The continuity equation $\partial u/\partial x+\partial v/\partial y+\partial w/\partial z=0$ is valid for	[ ]
	(a) ideal fluid flow only (b) incompressible fluids or unsteady (c) incompressible fluids and steady flow (d) steady flow	
9.	The path traced by a single particle of smoke issuing from a cigarette is	[ ]
	(a) stream line (b) path line (c) streak line (d) flow line	
10.	A stream function	[ ]
	(a) is defined only for steady and incompressible flow (b) is a mathematical function which has no physical equivalent (c) may not remain constant for a streamline (d) satisfies the Laplace equation for rotational motion	

S Baliram, Assistant Professor, CE