SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

III SEMESTER

CE 3362 FLUID MECHANICS

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Prepared by

Mr. J. Arunraj Christadoss

Assistant Professor / Civil

SRM VALLIAMMAI ENGINEERING COLLEGE
SRM Nagar, Kattankulathur – 603 203.

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SUBJECT : CE 3362 / FLUID MECHANICS
SEM / YEAR : III/II

UNIT - I FLUID PROPERTIES AND FLUID STATICS

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures – pressure measurements by manometers-forces on planes – centre of pressure – buoyancy and floatation.

PART – A

Q. No	Questions	BT Level	Competence
1.	State Newton’s law of viscosity.	BT-1	Remember
2.	Define Mass Density.	BT-1	Remember
3.	Define Specific volume of a fluid and write its unit.	BT-1	Remember
4.	Name the devices that are used to measure the pressure of a fluid.	BT-1	Remember
5.	Define compressibility of a fluid.	BT-1	Remember
6.	State Pascal’s law.	BT-1	Remember
7.	Define total pressure on a surface and centre of pressure of a surface.	BT-1	Remember
8.	Classify the types of fluids and give some examples for the real fluids.	BT-2	Understand
9.	What is cohesion and adhesion in fluids?	BT-2	Understand
10.	Distinguish between dynamic viscosity and kinematic viscosity.	BT-2	Understand
11.	Write down the units for i) density, ii) viscosity.	BT-3	Application
12.	Relate the terms absolute pressure, gauge pressure and vacuum pressure.	BT-2	Understand
13.	Distinguish between a real fluid and an ideal fluid.	BT-2	Understand
14.	Differentiate between specific weight and specific gravity of an oil.	BT-2	Understand
15.	Briefly explain the term centre of buoyancy.	BT-3	Application
16.	Differentiate solid and fluid.	BT-3	Application
17.	Calculate the height of capillary rise for water in a glass tube of diameter 1 mm.	BT-3	Application
18.	Distinguish between gauge pressure and vacuum pressure.	BT-4	Analyse
19.	Two horizontal plates are placed 1.25 cm apart. The space between them is being filled with oil of viscosity 14 poises. Examine the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.	BT-4	Analyse
20.	Find the Kinematic viscosity of an oil having density 981 kg/m^3. The shearstressatapointinoilis0.2452N/m^2 and velocity gradient at that point is 0.2 /sec.	BT-4	Analyse
21.	Determine the specific gravity of a fluid having viscosity 0.00 Ns/m^2 and kinematic viscosity 0.035 x 10^{-4} m^2/s.	BT-5	Evaluate

22.	The Capillary rise in the glass tube is not to exceed 0.2 mm of water. Determine its minimum size, given that surface tension of waterin contact with air = 0.0725 N/m	BT-5	Evaluate
23.	Determine the specific gravity of a fluid having viscosity 0.05 Poise and kinematic viscosity 0.035 stokes.	BT-5	Evaluate
24.	Write the expression for capillary fall in terms of surface tension for mercury.	BT-6	Create
25.	Temperature rise, decreases viscosity in liquids but increases in gases, why?	BT-6	Create
	PART –B		
1.	i) Show the rheological classification of fluids and define each type of fluid giving an example. (8) ii) The capillary rise in a glass tube is to be restricted to 3 mm. what should be the size of the tube if the surface tension of water in contact with the air is 0.0725N/m. (5)	BT-1	Remember
2.	i) What are the units of mass density, specific weight, dynamic viscosity and kinematic viscosity in S.I units? (4) ii) A 400mm diameter shaft is rotating at 200 r.p.m in a bearing of length 120 mm. if the thickness of the oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 $N.S/m^2$, determine the torque required to overcoming friction in bearing and power utilized in overcoming viscous resistance. Assume a linear velocity profile. (9)	BT-1	Remember
3.	If the velocity profile of a fluid over a plate is a parabolic with the vertex 0.2 m from the plate, where the velocity is 1.2m/s. Calculate the velocity gradients and shear stresses at a distance of 0, m 0.1 and 0.2m from the plate, if the viscosity of the fluid is 8.5 poise.	BT-1	Remember
4.	A liquid has a specific gravity of 0.72. Find its density, specific weight and also the weight per litre of the liquid. If the above liquid is used for lubrication between a shaft and a sleeve, find the power lost in liquid for a sleeve length of 100 mm. The diameter of the shaft is 0.5m and the thickness of the liquid film is 1 mm. Take the viscosity of fluid as $0.5Ns/m^2$ and the speed of the shaft as 200 rpm.	BT-5	Evaluate
5.	The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5 mm.	BT-1	Remember
6.	i) Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is increased from 7 MN/m^2 to 13 MN/m^2, the volume of liquid decreases by 0.15%. (6) ii) Calculate the capillary effect in millimeters a glass tube of 4mm diameter, when immersed in (a) water (b) mercury. The temperature of the liquid is 20^oC and the values of the surface tension of water and mercury at 20^oC in contact with air are 0.073575 N/m and 0.51N/m respectively. The angle of contact for water is 0^oc and that for mercury 130^oC. Take specific weight of water as 9790 N/m^3. (7)	BT-3	Application
7.	Derive the expression for pressure head when fluid at a rest and develop an equation for Pascal's law.	BT-3	Application
8.	Explain centre of pressure and total pressure, also derive an expression	BT-3	Application

	for it.		
9.	i) What is capillarity? Derive an expression for capillary rise. ii) Determine the mass density, specific volume and specific weight of a liquid whose specific gravity 0.85.	BT-5	Evaluate
10.	A rectangular plate 0.6m wide and 1.2 m deep lies within a water body such that its plane is inclined at 45 degree to the horizontal and the top edge is 0.70 m below the water surface. Determine the total pressure on one side of the plate and the location of the centre of pressure.	BT-4	Analyse
11.	List the various devices used to measure fluid pressure and explain with a neat sketch.	BT-4	Analyse
12.	A U - Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and it is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, Calculate the new difference in the level of mercury. Sketch the arrangement in both cases.	BT-4	Analyse
13.	Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Also find the position of centre of pressure.	BT-5	Evaluate
14.	(i) A plate 0.05 mm distant from a fixed plate moves at 1.2 m/s and requires a shear stress of 2.2 N/m^2 to maintain this velocity. Find the viscosity of the fluid between the plates. (ii) What is the pressure within a 1mm diameter spherical droplet of a water relative to the atmospheric pressure outside ? Assume surface tension for pure water to be 0.073 N/m	BT-6	Create
15.	(i) Define and give practical examples of following properties. Also give their SI units. Explain their significance. (8) a. Viscosity, b. Vapour pressure c. Surface tension and capillarity, d. Bulk modulus of elasticity. (ii) The velocity distribution for flow over a plate is given by $U=2y-y^2$ where U is the velocity in m/s at a distance y meters above the plate. Determine the velocity gradient and shear stress at the boundary and 0.15m from it. (7)	BT-1	Remember
16.	i) Define the terms Gauge pressure, Vacuum pressure and Absolute Pressure. Indicate their relative positions. (8) ii) Differentiate and distinguish between Newtonian and non-Newtonian fluid in terms of viscosity. (7)	BT-2	Understand
17.	Derive an expression for the depth of centre of pressure from free surfaceof liquid of an inclined plane surface submerged in the liquid.	BT-3	Application
18.	(i) Derive an expression for the pressure inside a droplet, hollow bubbleand a free jet.(10) (ii) A plate 0.05 mm distance from a fixed plates moves at 75 cm/s and requires a force of 5 N per unit area to maintain this speed. Determine the fluid viscosity between the plates.(6)	BT-4	Analyse

UNIT-II	FLUID KINEMATICS AND DYNAMICS

Fluid Kinematics – Classification and types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net – Concept of velocity potential function and stream function with problems. Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli‟s equation – applications – venturi meter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend – Forces acting on fluid flow.

PART – A

Q. No	Questions	BT Level	Competence
1.	Define equipotential line.	BT-1	Remember
2.	State Bernoulli's theorem.	BT-1	Remember
3.	What are the types of fluid flows?	BT-1	Remember
4.	Define flow net.	BT-1	Remember
5.	Define Stream function.	BT-1	Remember
6.	What is meant by velocity potential function?	BT-1	Remember
7.	Differentiate compressible and incompressible flow..	BT-1	Remember
8.	What are the assumptions made in the derivation of Bernoulli's Equation? State its applications.	BT-1	Remember
9.	What are the types of motion of fluid particle?	BT-1	Remember
10.	Define rate of flow.	BT-1	Remember
11.	Classify the types of Motion.	BT-2	Understand
12.	Explain the impulse momentum principle.	BT-2	Understand
13.	Compare Laminar flow and turbulent flow.	BT-2	Understand
14.	Write and infer the equations of motion.	BT-2	Understand
15.	Distinguish between steady flow and unsteady flow	BT-2	Understand
16.	Name the different forces present in a fluid flow. For the Euler's equation of motion, what are all the forces taken into consideration?	BT-3	Application
17.	Write the properties of stream function.	BT-3	Application
18.	Give an expression for the rate of flow through venturimeter.	BT-3	Application
19.	Distinguish between stream line and streak line.	BT-4	Analyse
20.	Distinguish between uniform and non-uniform flow.	BT-4	Analyse
21.	What do you understand by Continuity Equation?	BT-4	Analyse

22.	A pitot - static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6mm and static pressure head is 5m. Calculate the velocity of flow assuming the co-efficient of tube equal to 0.98.	BT-5	Evaluate
23.	Can there be flow across a streamline? Why?	BT-5	Evaluate
24.	Write the expression for the resultant force acting between two sections of the pipe in terms of discharge using impulse-momentum principle.	BT-6	Create
25.	Give the relation between stream function and velocity potential function	BT-6	Create
	PART –B		
1	Water flows through a pipe AB 1.2 diameter at 3m/s and then passes through a pipe BC 1.5m diameter. At C, the pipe branches. Branch CD is 0.8m in diameter and carries one third of flow in AB. The flow velocity in branch CE is 2.5m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.	BT-1	Remember
2	State Bernoulli's theorem for steady flow of a incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumption made for such a derivation.	BT-4	Analyse
3	The stream function for a dimensional flow is given by $\Psi = 2xy$. Calculate the resultant velocity at P(3,4). Also the velocity potential function ϕ.	BT-3	Application
4	A venturimeter of inlet diameter 300 mm and throat diameter 150 mm is inserted in vertical pipe carrying water flowing in the upward direction. A differential mercury manometer connected to the inlet and throat gives a reading of 200 mm. Find the discharge if the coefficient of discharge of meter is 0.98.	BT-2	Understand
5	i) Describe continuity equation from principle of conservation of mass. ii) Derive the continuity equation for a three dimensional incompressible flow.	BT-2	Understand
6	Briefly describe about velocity potential function and stream function and its relations in terms of equation.	BT-2	Understand
7	Give a detailed account of equipotential lines and flow net. Also state the methods of flow net, its uses and limitations.	BT-2	Understand
8	If for a two – dimensional potential flow, the velocity potential function is given by $\phi = x(2y - 1)$, determine the velocity at the point P (4,5). Determine also the value of stream function (Ψ) at the point P.	BT-3	Application
9	The velocity component for a two dimensional incompressible flow are given by u= 3x–2y and v= -3y–2x. Show that the velocity Potential exists. Determine the velocity potential function and stream function.	BT-3	Application

10	An oil of sp .Gr. 0.8 is flowing through a venturimeter having an inlet diameter 20 cm and throat diameter 10 cm. The oil mercury differential manometer shows a reading of 25 cm. Examine the discharge of oil through the horizontal venturimeter, Take CD = 0.98.	BT-4	Analyse
11	The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, At the rate of 50 lit/sec. The pipe has a slope of 1 in 30. Find the pressure atthepressureatthelowerendifthepressureatthehigherlevelis 19.62 N/m^2	BT-4	Analyse
12	A 400 x 200 mm venturimeter is provided in a vertical pipe line carrying oil of relative density 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 250 mm. calculate the discharge of oil, if the coefficient of meter is 0.98.	BT-4	Analyse
13	A 40 cm diameter pipe, conveying water, branches into two pipes of diameters 30cm and 20cm respectively. If the average velocity in the 40 cm diameter pipe is 3m/s, find the discharge in this pipe. Also determine the velocity in 20 cm pipe if the average velocity in the 30 cm diameter pipe is 2m/s.	BT-5	Evaluate
14	Obtain the Euler's equation of motion and deduce that to Bernoulli's equation.	BT-6	Create
15.	If for a two dimensional potential flow, the velocity potential function is given by ϕ = x (2y-1), determine the velocity at the point P (4,5). Determine also the value of stream function (Ψ) at the point P.	BT-1	Remember
16.	i) What is meant by impulse momentum equation? Derive impulse momentum equation for a fluid. ii) What are the equations of motion? Find an expressions for it.	BT-3	Application
17.	Show that $Qact = C_d \, X \frac{a1a2}{\sqrt{a_1{}^2 - a_2{}^2}} X \sqrt{2gh}$ in the venturimeter for measuring the rate of flow of a fluid flowing through a pipe.	BT-4	Analyse
18.	(i) A pitot static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6m and static pressure head is 5m. Calculate the velocity of flow assuming the coefficient of tube equal to 0.98. (ii) An orifice meter with orifice diameter 15cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of sp.gr 0.9 When the coefficient of discharge of the orifice meter = 0.64.	BT-2	Understand

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES

Fundamental dimensions - dimensional homogeneity – Rayleigh's method and Buckingham Pi- Theorem - Dimensionless parameters - Similitude and model studies - Distorted models.

Part A

Q. No	Questions	BT Level	Competence
1	State the Buckingham‟s pi-theorem.	BT-1	Remembering
2	Distinguish between Geometric similarity and Kinematic similarity.	BT-4	Analyzing
3	List the steps in determining the π groups.	BT-1	Remembering
4	Check whether the equation $V = \sqrt{2gH}$, is dimensionally homogenous?	BT-4	Analyzing
5	Classify the methods of dimensional analysis.	BT-2	Understanding
6	What is meant by Similitude and mention its types.	BT-1	Remembering
7	Write the dimensions of the following quantities: a. Velocity b. Dynamic viscosity.	BT-5	Evaluating
8	Write short note on Dynamic similarity.	BT-3	Applying
9	Explain about model and model analysis.	BT-2	Understanding
10	Define dimensionless numbers and list any two dimensionless numbers.	BT-1	Remembering
11	Illustrate any three demerits of a distorted model.	BT-2	Understanding
12	Write two examples of a fluid flow situation where Froude model law is applied.	BT-6	Creating
13	Differentiate between model and prototype.	BT-4	Analyzing
14	Define the term dimensional homogeneity.	BT-1	Remembering
15	Define Reynold's number.	BT-1	Remembering
16	Name the similarity laws and identify its significance.	BT-3	Applying
17	How the fundamental quantities are involved in the dimensional analysis?	BT-5	Evaluating
18	Write short note on distorted model and undistorted model.	BT-3	Applying
19	What is meant by Froude number?	BT-6	Creating
20	Explain the applications of model testing.	BT-2	Understanding
21	State Mach's model law.	BT-1	Remembering
22	List various model laws applied in model analysis	BT-1	Remembering
23	Write the dimensions for the following 1) Mass density 2) Force.	BT-5	Evaluating
24	What do you infer from primary and derived quantities?	BT-1	Remembering
25	Define scale ratio. Evaluate scale ratio for area.	BT-1	Remembering

PART –B			
1.	i. State and explain about the Buckingham's pi-theorem. ii. Check the dimensional homogeneity of the following common equations in the field of hydraulics. a) Q = Cd. a.√2gH b) V = C$\sqrt{mi}$	BT-1	Remembering
2.	i. What is a distorted model? How it differs from an undistorted model. Discuss the advantages and disadvantages of distorted models. ii. A spillway model built upto a scale of 1/10 is discharging water with a velocity of 1m/s, under a head of 100 mm. Estimate the velocity of water of the prototype, if the head of water over the prototype is 5.5m.	BT-5	Evaluating
3.	The resisting force (R) of a supersonic flight can be considered as dependent upon length of aircraft (l), velocity (V), air viscosity „μ", air density „ρ", and bulk modulus of air „ k". State the functional relationship between these variables and the resisting force.	BT-1	Remembering
4.	By dimensional analysis, Show that the power P developed by a hydraulic turbine is given by $P = \rho N^3 D^5 f\ [N^2\ D^2/\ gH]$ where ρ - mass density of liquid, N - rotational speed, D – diameter of runner, H working head and g - acceleration due to gravity.	BT-3	Applying
5.	A 7.2 m height and 15 m long spillway discharge 94 m^3/s, under a head of 2 m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experience a force of 7500 N, Calculate the force on the prototype.	BT-3	Applying
6.	The variables controlling the motion of a floating vessel through water the drag force F, speed V, length L, density ρ, and dynamic viscosity μ of water and acceleration due to gravity g. Construct an expression for F by dimensional analysis.	BT-6	Creating
7.	Using Buckingham's pi theorem, Examine whether the velocity through a circular pipe orifice is given by, V = √2gHϕ [D/H , μ/ ρvH] where H = Head causing flow, D = diameter of orifice, μ = coefficient of viscosity ρ = mass density, g = acceleration due to gravity.	BT-4	Analyzing
8.	i. An oil of specific gravity 0.91 and viscosity of 0.03poise is to be transported at the rate of 3 m^3/s through a 1.3 m diameter pipe, Model tests were conducted on 130 mm diameter pipe using water having a viscosity of 0.01 poise. Estimate the velocity of flow and discharge in the model. ii. Discuss briefly the three types of Similarities between the model and the prototype.	BT-2	Understanding
9.	i. The efficiency of the fan depends on the density (ρ) dynamic viscosity (μ) angular viscosity (ω), diameter (D), Discharge (Q). Express efficiency in terms of dimensionless parameters using Rayleigh's method.(8) ii. Define similitude and mention the three types of similarity with definition.(5)	BT-4	Analyzing
10.	The frictional torque T of a disc diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by T = D5 N2ρ ϕ [μ/ D2N ρ]. Prove this by the method of dimensions.	BT-4	Analyzing
11	The efficiency η of a fan depends on density „ρ", dynamic viscosity „μ", and angular velocity „ω", diameter D of the rotor and the discharge Q. Evaluate η in terms of dimensionless parameters using Buckingham's pi method.	BT-2	Understanding
12	A spillway model is to be built to a scale ratio of 1:40 across a flume of 600 mm width. The prototype is 10 m high and maximum head expected is 1.5 m.	BT-1	Remembering

	i. Calculate the height of the model and the head on the model. ii. Calculate the flow over the prototype when the flow over the model is 12 lps. iii. If a negative pressure of 0.15m occurs in the model, what will be the negative pressure in the prototype? Is this practically possible to occur. State it.		
13	i. The pressure drop in an airplane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Analyse the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. (7) ii. A 1.64 model is constructed on open channel in concrete which has manning‟s N = 0.014. Find the value of N for the models. (6)	BT-4	Analyzing
14	i. A pipe of dia 1.5 m is required to transport an oil of specific gravity 0.9 and viscosity 3x 10-2 poise at the rate of 3000 l/s. Tests were conducted on 15cm diameter by using water at 200c. Find the velocity and rate of flow in the model. Viscosity of water at 200c= 0.01 poise (8) ii. List out the types of forces acting in a moving fluid and explain it briefly. (5)	BT-1	Remembering
15.	Define Similitude and discuss its type of similarities in detail.	BT-1	Remembering
16.	The efficiency ŋ of geometrically similar fans depends upon the mass density of air ρ, its viscosity μ , speed of the fan N (revolutions per second), diameter of blades D and discharge Q . Perform dimensional analysis using Buckingham's theorem.	BT-3	Applying
17.	Discuss the types of non-dimensional numbers and derive any two of them. Also explain the significances of these dimensionless numbers for fluid flow problem.	BT-2	Understanding
18.	Consider the problem of computing the drag force on a body moving through a fluid. Let D, ρ, μ, l, and V be drag force, specific mass of the fluid, dynamic viscosity of the fluid, body reference length, and body velocity, respectively..	BT-4	Analyzing

UNIT IV FLOW THROUGH PIPES

Reynold's experiment - laminar flow through circular pipe (Hagen poiseulle's) - hydraulic and energy gradient – Flow through syphon pipe –flow through pipes - Darcy - Weisbach's equation - pipe roughness - friction factor- Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel.

PART –A

Q. No	Questions	BT Level	Competence
1.	Name the characteristics of laminar flow.	BT-1	Remember
2.	Describe the factors to be determined when viscous fluid flows through the circular pipe.	BT-1	Remember
3.	Define H.G.L	BT-1	Remember
4.	Define Reynolds number	BT-1	Remember
5.	Define the term "Vena Contract".	BT-1	Remember
6.	Define a) pipes in series b) pipes in parallel?	BT-1	Remember
7.	Differentiate Major and Minor headloss	BT-2	Understand

8.	Predict 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. Take kinematic viscosity of water is 0.01 stoke.	BT-2	Understand
9.	Differentiate laminar and turbulent flow.	BT-2	Understand
10.	Describe Darcy formula. How will you interpret the loss of head due to friction in pipes?	BT-2	Understand
11.	Using Hagen Poisuille"s derivation, show the formula for average velocity and velocity distribution.	BT-3	Application
12.	Illustrate the expression for drop of pressure for a given length of a pipe.	BT-3	Application
13.	Relate an expression for co efficient of friction in terms of shear stress.	BT-3	Application
14.	Compare hydraulic gradient line with total energy line.	BT-4	Analyse
15.	Explain the significance of Moody diagram.	BT-4	Analyse
16.	Explain the terms a) major energy loss, b) minor energy loss.	BT-4	Analyse
17.	Formulate Hagen Poisuille's equation.	BT-5	Evaluate
18.	Formulate an expression for loss of head due to sudden enlargement and sudden contraction of the pipes.	BT-5	Evaluate
19.	Summarize the properties of pipe roughness	BT-6	Create
20.	Draw and assess the shear stress and velocity distribution diagram for the viscous flow in a circular conduit.	BT-6	Create
21	What are the fluid machines or hydraulics?	BT-1	Remember
22	Define gross head of the turbine	BT-1	Remember
23	What are the efficiencies of a turbine?	BT-1	Remember
24	Define impulse and reaction turbine	BT-1	Remember
25	Classification of hydraulic machines	BT-2	Understand
	PART –B		
1.	An oil of Sp. Gr 0.9 and viscosity 0.06 poise is flowing through a pipe ofdiameter 200 mm at the rate of 60 liters/sec. Identify the head lost due to friction for a 500 m length of pipe. Also identify the power required tomaintain this flow.	BT-1	Remember
2.	Examine the head lost due to friction in a pipe of diameter 300mm and length 50m, through which water is flowing at a velocity of 3m/s using (i) Darcy formula, (ii) Chezy"s formula for which C = 60.	BT-1	Remember
3.	An oil of viscosity 0.1NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 5cm and of length 300m. The rate of flow of fluid through the pipe is 3.5 liters/sec. Examine the pressure drop in a length of 300 m and also the shear stress at the pipe wall.	BT-1	Remember
4.	The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller is 11.772 N/cm^2. Identify the (i) loss of head due to sudden enlargement, (ii) pressure intensity in the large pipe, (iii) power lost due to enlargement.	BT-1	Remember

5.	i) A crude oil of kinematic viscosity 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 litres per sec. Estimate the head lost due to friction for a length of 50 m of the pipe. (7) ii) An oil of viscosity 1 N-s/m^2 flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Estimate the discharge of oil between the plates. If the drop of pressure in a length of 1.2m be 3 kN/m^2. The width of the plate is 200mm. (6)	BT-2	Understand
6.	The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12m. Estimate the rate of flow of water if co – efficient of friction are 0.005, 0.0052 and 0.0048 respectively, considering: (i) minor losses also (ii) neglecting minor losses.	BT-2	Understand
7.	Two pipes of diameter 400mm and 200mm are each 300m long. When the pipes are connected in series the discharge through the pipeline is 0.10m3/sec, Estimate the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel. Take friction factor = 0.0075 for each pipe.	BT-2	Understand
8.	Derive an expression for the loss of head due to sudden enlargement and sudden contraction of a pipe.	BT-3	Application
9.	A main pipe divides into 2 parallel pipes which again forms one pipe as shown in fig. the length and diameter for the 1st parallel pipe are 2000 m and 1 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Calculate the rate of flow in each parallel pipe, if the total flow in the main is 3 m^3/s. the coefficient of friction for each parallel pipe is same and equal to 0.005.	BT-3	Application
10.	A pipe of diameter 20 cm and length 2000 m is connects two reservoirs, having difference of water levels as 20 m. Analyse the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take f = 0.015 and neglect minor losses.	BT-4	Analyse
11.	A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, analyse the increase in discharge if 4f=0.04.The head at inlet is 300 mm.	BT-4	Analyse
12.	Analyse the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the center of the pipe. Consider all minor losses and take f=0.009 in the formula $h_f = (4fLV^2)/(2gd)$	BT-4	Analyse
13.	A pipe of diameter 20 cm and length 2000 m is connects two reservoirs, having difference of water levels as 20 m. design the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, compose the increase in the discharge. Take f=0.015 and neglect minor losses.	BT-5	Evaluate

14.	i) If a pipe line of 300 mm diameter and 3200 m long is used to pump up 50 kg per second of oil whose density is 950 kg/m^{3}and whose kinematic viscosity is 2.1 stokes, the center of the pipe line at the upper end is 40 m above than that at the lower end and the discharge at upper end is atmospheric, decide the pressure at the lower end & draw and assess the hydraulic gradient and the total energyline. (9) ii) A pipe line 60 cm diameter bifurcates at a Y- junction into two branches 40 cm and 30 cm in diameter. If the rate of flow in the main pipe is 1.5 m^3/s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s, measure the rate of flow in the 40 cm diameter pipe. (4)	BT-6	Create
15.	Derive an expression for Hagen Poisuille‟s equation.	BT-3	Apply
16.	i) Compare chezy‟s formula with Darcy‟s formula. (5) ii) Expalin an expression for the Darcy weisbach equation. (10)	BT-4	Analyse
17.	Design the loss of head if the pipes are connected in series (compound pipes),equivalent and in parallel.	BT-5	Analyse
18.	A horizontal pipe line 40 m long is connected to a water tank at one end discharges freely into the atmosphere at the 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 the pipe. Considering all losses of head which occur, measure the rate of flow (discharge). Take Darcy‟s co-efficient of friction as 0.01 for both sections of the pipe.	BT-6	Create

UNITV BOUNDARY LAYER

Boundary layer – definition-Development of boundary layer thickness and its application boundary layer on a flat plate – laminar and turbulent boundary layer- displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation and control – drag on flat plate.

Part A

Q. No	Questions	BT Level	Competence
1.	List out the methods of preventing the separation of a Boundary layer.	BT-1	Remember
2.	List out the assumptions made in the analysis of boundary layer development.	BT-1	Remember
3.	Describe the term Laminar Sub – layer?	BT-1	Remember
4.	Define boundary layer thickness	BT-1	Remember
5.	List out the conditions for separation of boundary layer.	BT-1	Remember
6.	Define energy thickness.	BT-1	Remember
7.	Differentiate displacement thickness and energy thickness.	BT-2	Understand
8.	Differentiate between Laminar boundary layer and turbulent boundary layer.	BT-2	Understand
9.	Distinguish between local co-efficient of drag and average co-efficient of drag.	BT-2	Understand
10.	Discuss about the applications of Von Karman momentum integral equation.	BT-2	Understand
11.	Illustrate the term “Boundary Layer”.	BT-3	Application

12.	Illustrate the terms: Drag and Lift.	BT-3	Application
13.	Illustrate the examples of formation of boundary layer in day to day life.	BT-3	Application
14.	Explain the diagram for drag force on a plate due to boundary layer.	BT-4	Analyse
15.	Infer how the drag and lift acting on a body moving in a fluid of density ρ at a uniform velocity U are calculated mathematically.	BT-4	Analyse
16.	Explain the Boundary layer theory.	BT-4	Analyse
17.	Generalize the drag force from a lift force?	BT-5	Evaluate
18.	Formulate the values of boundary layer thickness and drag co – efficient for Blasius‟s solution.	BT-5	Evaluate
19.	Assess the Von Karman momentum integral equation.	BT-6	Create
20.	Recommend the boundary conditions for the velocity profiles.	BT-6	Create
21	What is the work done by reciprocating pump per second.	BT-1	Remember
22	Define slip and % slip.	BT-1	Remember
23	Define Laminar boundary layer	BT-1	Remember
24	Define transition zone	BT-1	Remember
25	Define kinetic energy correction factor	BT-1	Remember
	PART – B		
1.	For the velocity profile for laminar boundary layer $u/U = (3/2)(y/\delta) - (1/2)(y/\delta)^3$. Identify the boundary layer thickness, shear stress, drag force and coefficient of drag in terms of Reynold Number.	BT-1	Remember
2.	Air is flowing over a flat plate 500 mm long and 600 mm wide with a velocity of 4 m/s. The kinematic viscosity of air is given as 0.15×10^{-4} m^2/s. Identify i) the boundary layer thickness at the end of the plate, ii) shear stress at 200 mm from the leading edge and iii) drag force on one side of the plate. Take the velocity profile over the plate as $u/U = \sin(\pi/2 \, y/\delta)$ and density of air is 1.24 kg/m^3.	BT-1	Remember
3.	For the following velocity profiles, Examine whether the flow has or on the verge of separation or will attach with the surface: i) $u/U = 3/2\,(y/\delta) - 1/2\,(y/\delta)^3$ ii) $u/U = 2\,(y/\delta)^2 - (y/\delta)^3$ iii) $u/U = -2\,(y/\delta) + (y/\delta)^2$	BT-1	Remember
4.	Define the terms displacement thickness and momentum thickness and also derive an expression for the displacement thickness and momentumthickness in boundary layer with necessary assumptions.	BT-1	Remember
5.	Discuss the concept of boundary layer formation, derive the expression for displacement thickness and list the methods of boundary layer separation.	BT-2	Understand

6.	For the velocity profile for laminar boundary layer $u/U = 3/2 (y/\delta) - 1/2 (y/\delta)^3$ find the thickness of the boundary layer and the shear stress 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide and is placed in water which is moving with a velocity of 200 mm per second. Estimate the total drag force on the plate if μ for water = 0.01 poise.	BT-2	Understand
7.	A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m/s. If the crude oil has a specific gravity of 0.8 and kinematic viscosity of 1 stoke, Estimate: i) Boundary layer thickness at the middle of the plate. ii) Shear stress at the middle of the plate. iii) Friction drag on one side of the plate.	BT-2	Understand
8.	i) Calculate the thickness of the boundary layer at the trailing edge of smooth plate of length 4 m and of the width 1.5 m, when the plate is moving with a velocity of 4 m/s in stationary air. Take kinematic viscosity of air as $1.5 \times 10^{-5} m^2/s$. (7) ii) Oil with a free-stream velocity of 3 m/s flows over a thin plate of 1.25 m wide and 2 m long. Calculate the boundary layer thickness at mid length and also calculate the total double sided resistance of the plate. Take density as 860 kg/m^3 and kinematic viscosity as $10^{-5} m^2/s$. (6)	BT-3	Application
9.	For the velocity profile for laminar boundary layer $u/U = 2(y/\delta) - 2(y/\delta)^3 + (y/\delta)^4$ derive an expression for boundary layer thickness, shear stress, drag force on one side of the plate and co – efficient of drag in terms of Reynold number.	BT-3	Application
10.	Analyze the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = y/\delta$, whereuisthevelocityatadistanceyfromtheplateandu=Uaty=δ, where δ = boundary layer thickness. Also calculate the value of δ^*/θ.	BT-4	Analyse
11.	Analyze the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U=2(y/\delta) - (y/\delta)^2$.	BT-4	Analyse
12.	Analyze the following boundary layer parameters for the velocity distribution $u/U = (y/\delta)^{2/3}$: i) Displacement thickness, ii) Momentum thickness, iii) Energy thickness, iv) Shape factor.	BT-4	Analyse
13.	A plate of 600 mm length and 400 mm wide is immersed in a fluid of sp.gr 0.9 and kinematic viscosity $v = 10^{-4} m^2/s$. The fluid is moving with the velocity of 6m/s. Design:) Boundary Layer thickness) Shear stress at the end of the plate) Drag force on one of the sides of the plate.	BT-5	Evaluate

14.	A flat plate of 2 m width and 5 m length is kept parallel to air flowing at 4 m/s velocity. Measure) The length of the plate over which the boundary layer is laminar) Boundary layer thickness) Shear stress Take density = 1.2 kg/m^3 and kinematic viscosity as $1.4 \times 10^{-5} m^2/s$.	BT-6	Create
15.	A thin plate is moving in still atmospheric air at a velocity of 5 m/s. The length of the plate is 0.6 m and width is 0.5 m. Estimate : i) The thickness of the boundary layer at the end of the plate ii) Drag force on one side of the plate. Take density of air as 1.24 kg/m^3 and kinematic viscosity of 0.15 stokes.	BT-2	Understand
16.	Analyze an expression for a drag force on a flat plate due to boundary layer.	BT-4	Analyse
17.	Briefly explain the terms i) Laminar Boundary Layer ii) Turbulent Boundary Layer iii) Boundary Layer Thickness iv) Laminar Sub-Layer	BT-4	Analyse
18.	Formulate an expression for Von Karman momentum integral equation.	BT-5	Evaluate