SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURAL ENGINEERING

QUESTION BANK

III SEMESTER

AG3361–Fluid Mechanics and Open Channel

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QUESTION BANK

SUBJECT: AG3361–Fluid Mechanics and Open Channel

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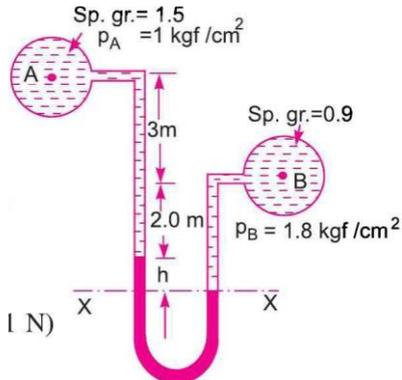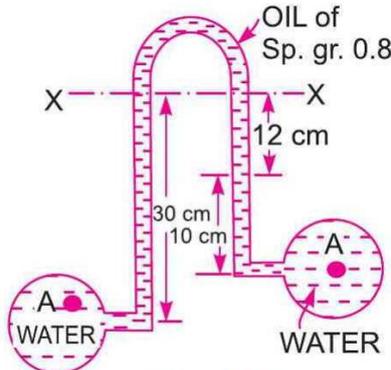### UNIT I - PROPERTIES OF FLUID

Properties of fluids–definition–units of measurement– Pressure Measurement –Fluid Statics. Hydrostatic forces on surfaces. Archimedes principles– buoyancy- metacentre– metacentric height.

	PART – A		
Q.No	Questions	BT Level	Competence
1.	Distinguish between gauge pressure and vacuum pressure	BT-1	Remember
2.	Write down the expression for capillary fall in terms of surface tension	BT-1	Remember
3.	Explain Newton's Law of Viscosity.	BT-1	Understand
4.	Classify the Types of fluids	BT-1	Remember
5.	What are the properties of real fluid?	BT-1	Evaluate
6.	Define Centre of Pressure	BT-1	Remember
7.	Define Mass Density	BT-1	Remember
8.	Define specific gravity	BT-1	Remember
9.	Define Buoyancy	BT-1	Remember
10.	Define Compressibility	BT-1	Remember
11.	Define Surface tension and Capillarity	BT-1	Remember
12.	Name the devices that are used to measure the pressure of a Fluid	BT-2	Understand
13.	Relate absolute pressure and gauge pressure	BT-2	Understand
14.	How does solid and fluid response to deformation when constant shear force is applied?	BT-2	Understand
15.	Compare specific weight and specific volume	BT-2	Understand
16.	Distinct between statics and kinematics.	BT-2	Understand
17.	Give the difference between liquid and gas.	BT-1	Remember
18.	Find the kinematic viscosity of oil having density 981 kg/m^3. The shear stress at a pointin oil is 0.2452N/m^2 and velocity gradient at that point is 0.2m/sec.	BT-2	Understand
19.	Differentiate fluid and liquids.	BT-2	Understand
20.	State Archimedes principle.	BT-1	Remember

21.	Write the value of specific gravity and density of water and mercury.	BT-2	Understand
22.	State pascal''s law	BT-1	Remember
23.	What is manometric liquid and where it is used?	BT-1	Understand
24.	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-2	Understand

PART - B

1.	a. A plate 0.0025 mm distance from a fixed plate, moves at 60 cm/s and requires a force of 2N per unit area i.e., 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.	BT-3	Application
	b. Determine the intensity of shear of an oil having viscosity = 1 poise. The oil is used for lubricating clearance between the shaft of diameter 10 cm and its journal bearing. The clearance is 1.5 mm and the shaft rotates at 150 r.p.m.		
2.	A vertical gap 2.2 cm wide of infinite extent contains a fluid of viscosity 2.0 N s/ m^2 and specific gravity 0.9. A metallic plate 1.2 m X 1.2 m X 0.2 cm is to be lifted up with a constant velocity of 0.15 m/sec, through the gap. If the plate is in the middle of the gap, find the force required. The weight of the plate is 40 N.	BT-3	Application
3.	Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is increased from 70 N/ cm^2. The volume of the liquid deceased by 0.15 per cent.	BT-4	Analyses
	An oil viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 r.p.m. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm.	BT-4	Analyses
4.	Calculate the pressure due to a column of 0.3 of (i) water (ii) an oil of sp.gr. 0.8 and (iii) mercury of sp.gr. 13.6. Take density of wate, $\rho = 1000$ kg/m^3.	BT-3	Application
5.	Explain the following with an example: (i) Newtonian fluid (ii) Non-Newtonian fluid (iii) Vapour pressure (iv) Compressibility	BT-3	Application

	(v) Dynamic and kinematic viscosity		
6.	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 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 center 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-5	Evaluate
7.	A differential manometer is connected at the two points A and B of two pipe as shown in Fig. The pipe A contains a liquid of sp.gr. = 1.5 while pipe B contains a liquid of sp.gr. = 0.9. The pressure at A and B are 1 kgf/cm^2 respectively. Find the difference in mercury level in difference manometer. 	BT-4	Analyses
8.	Water is flowing through two different pipes to which an inverted differential manometer having an oil of sp.gr. 0.8 is connected. The pressure head in the pipe A is 2m of water, find the pressure in the pipe B for the manometer readings as shown in Fig. 	BT-5	Evaluate

9.	Briefly explain about the different pressure measuring devices with a neat sketch.	BT-3	Application
10.	A rectangular plane surface is 2m wide and 3 m deep. It lies in vertical plane in water. Determine the total pressure and position of center of pressure on the plane surface when its upper edge is horizontal and (a) coincides with water surface, (b) 2.5 m below the free water surface.	BT-3	Application
11.	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 center of the plate is 3 m below the free surface of water. Find the position of center of pressure also.	BT-4	Analyses
12.	A rectangular plane surface 3m wide and 4 m deep lies in water in such a way that its plane makes an angle of 30° with free surface of water. Determine the total pressure force and position of center of pressure, when the upper edge is 2m below the free surface.	BT-3	Application
13.	Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid.	BT-3	Application
14.	Find the volume of the water displaced and position of center of buoyancy for a wooden block of width 2.5 m and depth of 1.5 m, when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length 6.0 m.	BT-5	Evaluate
15.	A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2 m X 1 m X 0.8 m	BT-3	Application
16.	What are the conditions of equilibrium of a floating body and sub-merged body? How will you determine the meta-centric height of floating body experimentally? Explain with neat sketch.	BT-3	Application
17.	Show that the distance between the meta center and center of buoyance is given by $BM = \frac{I}{\forall}$. where I = Moment of inertia of plan of the floating body at water surface about longitudinal axis. $\forall$ = volume of body sub-merged in liquid.	BT-4	Analyses

UNIT II - FLUID FLOW ANALYSIS

Types of fluid flow–Fluid Kinematics - Flow pattern – stream line – equipotential line – stream tube pathline – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates-Euler's equation of motion.

Q.No	Questions	BT Level	Competence
	PART – A		
1.	Classify the types of Motion	BT-2	Understand
2.	What do you understand from Continuity Equation?	BT-1	Remember
3.	List the properties of potential function.	BT-1	Remember
4	Write the integral form of momentum equation	BT-1	Remember
5.	What do you infer from vorticity?	BT-2	Understand
6.	Define flow net.	BT-1	Remember
7.	Define Stream function.	BT-1	Remember
8.	Define velocity potential function.	BT-1	Remember
9.	Define "Vortex flow"	BT-1	Remember
10.	State Principles of conservation of mass	BT-1	Remember
11.	Enumerate the equation velocity of fluid flow	BT-1	Remember
12.	Compare Laminar flow and turbulent flow	BT-2	Understand
13.	What are flow pattern obtained in fluid flow?	BT-2	Understand
14.	Define rate of flow.	BT-2	Understand
15.	Define Principles of conservation of energy.	BT-2	Understand
16.	Write the properties of stream function	BT-1	Remember
17.	Write the continuity equation.	BT-1	Remember
18.	Distinguish between stream line and streak line.	BT-2	Understand
19.	Outline the expression for Circulation.	BT-2	Understand
20.	Distinguish between uniform and non-uniform flow	BT-1	Remember
21	What is stream tube path line?	BT-2	Understand
22	Write and infer the equations of motion.	BT-1	Remember
23	Define circulation and write its expressions	BT-2	Understand
24	Illustrate the equation for acceleration of flow of fluid.	BT-2	Understand

1.	Two velocity components are given in the following cases, find the third component such that they satisfy the continuity equation
	     a) $u = x^3 + y^2 + 2z^2$; $v = -x^2y - yz - xy$
	     b) $u = \log(y^2 + z^2)$; $v = \log(x^2 + z^2)$
		BT-3	Application

2.	The velocity components in a two-dimensional field for an incompressible fluid are expressed as $u = (y^3/3) + 2x - x^2y$; $v = xy^2 - 2y - (x^3/3)$
	     a) obtain the expression for stream function
	     b) obtain the expression for velocity potential
		BT-3	Application

3.	For a three-dimensional flow field described by $V = (y^2 + z^2)\,\mathbf{i} + (x^2 + z^2)\mathbf{j} + (x^2 + y^2)\mathbf{k}$. Find at (1,2,3) a) the components of acceleration b) the components of rotation.	BT-4	Analysis
4.	For a two dimensional flow $\Phi = 3xy$ and $\Psi = (y^2 - x^2)\,3/2$. Determine the velocity components at the points (1,3) and (3,3). Also find the discharge passing between the streamlines passing through the points given above.	BT-3	Application
5.	If for a two-dimensional potential flow, the velocity potential 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	Evaluate
6.	The velocity components of the two dimensional plane motion of a fluid are $u = \dfrac{y^2 - x^2}{(x2 + y2)^2}$ and $v = \dfrac{-2xy}{(x2 + y2)^2}$. Show that the fluid is incompressible and flow is irrotational.	BT-4	Analysis
7.	a) A stream function is given by $\Psi = 3x^2 - y^3$. Determine the magnitude of velocity components at the point (2, 1). b) A stream function in a two dimensional flow is $\Psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential Φ.	BT-4	Analysis
8.	a) Derive Euler equation of motion b) Derive 3D continuity equation in differential form	BT-3	Application
9.	The water flowing through a pipe having diameter 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe	BT-4	Analysis

	is 35 liters/s. The section 1 is 6 m above 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.		
10.	In a three dimensional flow, the components of velocity are u = xy, v = 4yz^3 and w = - (yz + z^4). Test whether the continuity equation for incompressible fluid flow is satisfied. Determine the acceleration vector at point (1, 1, 1).	BT-4	Analysis
11.	For a two dimensional irrotational flow, the velocity potential is defined as $\Phi = \log_e(x^2 + y^2)$. Find the possible stream function(Ψ) for this flow.	BT-4	Analysis
12.	The velocity of an incompressible fluid flow is given by U = (Px – Q)i + Ryj + Stk m/s where P = 3 s^{-1}, Q = 4 m/s, R = 3 s^{-1} and S = 5 m/s2. Find the local and convective acceleration components at x =1m, y = 2m and t = 5s.	BT-4	Analysis
13.	The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation (i) u = x^2 + y^2 + Z^2; v = xy^2 – yz^2 + xy (ii) v = 2y^2, w = 2xyz.	BT-4	Analysis
14.	Define the following and give one practical example for each (i) Laminar flow (ii) Turbulent flow (iii) Velocity potential function (iv) Stream function	BT-3	Application
15.	The velocity vector in a fluid flow is given as V=4x^{3}i-10x^{2}yj+2tk. Find the velocity and acceleration of a fluid particle at (2,1,3) at time t=1.	BT-3	Application
16.	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.	BT-3	Application
17.	Water is flowing through a tapering pipe having diameters of 300 mm and 150 mm at sections 1 and 2 respectively. The discharge through the pipe is 35 litres/s. The section 1 is 8 m above datum line and section 2 is 4m above datum. Find the intensity of pressure at section 2 if such intensity at section 1 is 400 kN/m^2	BT-3	Application

UNIT III - FLOW MEASUREMENT

Bernoulli's equation its applications – Orifice – sharp edged orifice discharging free - submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes —Chezy's formula – Manning's formula – Hazen- William" s formula - Major and minor losses in pipes– Pipe network.

PART – A			
Q.No	Questions	BT Level	Competence
1.	Define Reynolds number	BT-1	Remember
2.	Name the characteristics of laminar flow	BT-2	Understand
3.	Analyze pipe in series	BT-2	Understand
4.	Formulate equation of head loss due to friction.	BT-2	Understand
5.	Write the advantages of venture meter over orifice meter.	BT-1	Remember
6.	What are the minor losses?	BT-1	Remember
7.	Compare hydraulic gradient line with total energy line.	BT-1	Remember
8.	Differentiate orifice meter and orifice	BT-2	Remember
9.	Relate an expression for co efficient of friction in terms of shear stress.	BT-1	Remember
10.	Write the application of Bernoullis equation.	BT-1	Remember
11.	Differentiate laminar and turbulent flow	BT-1	Remember
12.	Outline major loss in pipe.	BT-2	Understand
13.	Write about pipes in parallel.	BT-2	Understand
14.	Illustrate the disadvantages of orificemeter.	BT-2	Understand
15.	Illustrate the expression for drop of pressure for a given length of a pipe	BT-2	Understand
16.	Outline about water hammer in pipes.	BT-2	Understand
17.	Derive an expression for Chezys formula.	BT-1	Remember
18.	Classify flow based on Reynolds number.	BT-1	Remember
19.	Write about HazensWillams equation.	BT-2	Understand
20.	Illustrate about time for empty of tank	BT-1	Remember
21	Enumerate an expression for mannings formula	BT-2	Understand
22	Give the relation between friction and chezys constant.	BT-1	Remember
23	Formulate Hagen Poisuille"s equation.	BT-1	Remember
24	What are the effect observed due to sudden closure of value in pipe flow?	BT-2	Understand

PART – B

1.	A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is 4 meters at a higher level. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 liters/s determine the loss of head and direction of flow.	BT-3	Application
2.	A 0.3 m pipe carries water at a velocity of 24.4 m/s. At points A and B measurements of pressure and elevation were respectively 361 kN/m^2 and 288 361 kN/m^2 and 30.5 m and 33.5 m. For steady flow , find the loss of head between A and B.	BT-4	Analysis
3.	A oil of sp.gr. 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take C$_d$ = 0.98.	BT-3	Application
4	A venturimeter having a diameter of 75mm at the throat and 150mm diameter at the enlarged end is installed in a horizontal pipeline 150mm in diameter carrying an oil ofspecific gravity 0.9. The difference of pressure head between the enlarged end and the throat recorded by U-tube is 175mm of mercury. Determine the discharge through pipe. Assume the coefficient of discharge of the meter as 0.97.	BT-4	Analysis
5.	A venturimeter has its axis vertical, the inlet and throat diameters being 150mm and 75mm respectively. The throat is 225mm above inlet and K = 0.96. Petrol of specific gravity 0.78 flows up through the meter at a rate of 0.029m^3/s. Find the pressure difference between the inlet and the throat.	BT-3	Application
6.	An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauge fitted upstream and downstream of the office meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the orifice meter is given as 0.6. Find the discharge of water through pipe.	BT-3	Application
7.	Water discharges at the rate of 98 litres per second through a 0.12 m diameter vertical sharp edged orifice placed under a constant head of 18m. A point on the jet measured from the	BT-3	

	vena-contracta of the jet has coordinates 4.5m horizontal and 0.54 m vertical. Find a) the coefficients C_c, C_v, C_d and C_r for the orifice and b) the power lost at the orifice.		Application
8.	A rectangular orifice 1.5m wide and 1.0m deep is discharging water from a tank. If the water level in the tank is 3.0m above the top edge of the orifice. Find the discharge through the orifice. Take the coefficient of discharging for the orifice = 0.6.	BT-3	Application
9.	a) Find the discharge through a fully sub merged orifice of width 2m if the difference of water levels on both sides of the orifice be 50cm. The height of water from top and bottom of the orifice are 2.5m and 2.75m respectively. Take $C_d = 0.6$ b) A rectangular orifice of 2 m width and 1.2 m deep is fitted in one side of a large tank. The water level on one side of the orifice is 3 m above the top edge of the orifice, while on the other side of the orifice, the water level is 0.5 m below its top edge. Calculate the discharge through the orifice if $C_d = 0.64$	BT-5	Evaluate
10.	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 (i) Darcy formula, (ii) Chezy's formula for which C =60	BT-4	Analyse
11.	Determine the wall shearing stress in a pipe of diameter 100 mm which carries water. The velocity at the pipe center and 30 mm from the pipe center are 2 m/s and 1.5 m/s respectively. The flow in pipe is given as turbulent.	BT-4	Analyse
12.	Water is flowing through a rough pipe of diameter 500 mm and length 4000 m at the rate of 0.5 m^3/s. Find the power required to maintain this flow. Take the average height of roughness as k = 0.40 mm.	BT-3	Application
13.	An oil of sp.gr. 0.7 is flowing through a pipe of diameter 300 mm at a rate of 500 liters/s. Find the head lost due to friction and power required to maintain the flow for a length of 1000 m. Take $v = 0.29$ stokes.	BT-5	Evaluate
14.	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 pipe is 11.772 N/cm^2. Determine:	BT-4	Analyse

	i) Loss of head due to sudden enlargement ii) Pressure intensity in the large pipe iii) Power lost due to enlargement			
15.	A main pipe divides into two parallel pipes which again forms one pipe as shown in Fig. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 3.0 m³/s. the co-efficient of friction for each parallel pipe is same and equal to 0.005. 	BT-5	Evaluate	
16.	State Bernoulli's theorem for steady flow of a incompressible third. Derive an expression for Bernoulli's equation from first principle and state the assumption made for such a derivation.	BT-3	Application	
17.	a) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 liters/s. b) Three pipes of length 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length in1700 m. Find the diameter of the single pipe.	BT-3	Application	

UNIT IV - OPEN CHANNEL FLOW

Types of flow in channel – most economical section of channel. Specific energy and critical depth-momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – float method - Flow measurement in rivers– current meter – Parshall flume.

PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Differentiate afflux and backwater curve.	BT-2	Understand
2.	Write about non-erodible channels	BT-2	Understand
3.	State the critical flow.	BT-1	Remember

4.	Find the critical depth and critical velocity of a water flowing through a rectangular channel of width 5 m, when the discharge is 15 m^3/s.	BT-1	Remember
5.	Define hydraulic mean depth.	BT-1	Remember
6.	List the factors affecting Manning's roughness coefficient.	BT-1	Remember
7.	Define open channel flow with example.	BT-1	Remember
8.	Define uniform flow in channels.	BT-1	Remember
9.	Sketch the velocity distribution in rectangular and triangular channels.	BT-1	Remember
10.	Compare the prismatic channel with the non-prismatic channel.	BT-1	Remember
11.	What is meant by most economical section?	BT-1	Remember
12.	Derive the dimension of constant 'C' in chezy's formula.	BT-2	Understand
13.	What is meant by specific force?	BT-1	Remember
14.	Give the relationships between Chezy's'C' and Manning's 'n'.	BT-2	Understand
15.	What are surges in an open channel flow?	BT-2	Understand
16.	State the flow conditions for the occurance of hydraulic jump	BT-2	Understand
17.	State the condition for efficient rectangular section.	BT-2	Understand
18.	Write the condition for efficient circular section.	BT-1	Remember
19.	Find the critical height for a trapezoidal section.	BT-2	Understand
20.	What is specific energy and what is the condition for getting only one depth for a given specific energy?	BT-1	Remember
21.	Define and distinguish between steady flow and unsteady flow.	BT-2	Understand
22.	Compute the hydraulic mean depth of a small channel of 1m wide and 0.5m deep with water flowing at 2m/s.	BT-2	Understand
23.	Differentiate closed conduit flow and open channel flow.	BT-1	Remember
24.	Outline different types of notches	BT-2	Understand

PART - B

1.	Determine the most efficient section of a trapezoidal channel with „n" = 0.025 to carry a discharge of 15 m^3/secto prevent scouring, the maximum velocity is to be 1 m/sec and the side slope of the trapezoidal channel are 1 vertical to 2 horizontal.	BT-3	Application

2.	An irrigation channel of trapezoidal section, having side slopes 3 horizontal to 2 vertical, is to carry a flow of 10 cumec on a longitudinal slope of 1 in 5000. The channel isto be lined for which the value of friction coefficient in Manning's formula is n = 0.012. Find the dimensions of the most economic section of the channel.	BT-4	Analyse
3.	An earthen channel with a base width 2m and side slope 1 horizontal to 2 vertical carries water with a depth of 1m. The bed slope is 1 in 625. Calculate the discharge if n = 0.03. Also calculate the average shear stress at the channel boundary.	BT-3	Application
4.	Find the discharge through a circular pipe of diameter 3.0 m, if the depth of water in the pipe is 1.0 m and the pipe is laid at a slope of 1 in 1000. Take the value of Chezy"s constant as 70.	BT-4	Analyse
5.	A trapezoidal channel, shown in the fig carries a water discharge of 10 m^3/sec uniform flow conditions. The long slope of the channel bed is 0.01. Compute the average shear stress in N/mm^2 on the boundary. Also compute mannings "n" value.	BT-3	Application
6.	An irrigation channel is to carry full supply discharge of 30 m^3/sec at a velocity of 1.75 m/sec. The side slopes are to be 1H : 1V. The ratio of full supply depth to bet width is to be 1 : 6. Assuming the Manning"s "n" as 0.018, calculate the full supply depth, bed width and bed slope of the channel.	BT-5	Evaluate
7.	The discharge of water through a rectangular channel of width 8 m, is 15 m^3/s when depth of flow of water is 1.2 m. Calculate :i) Specific energy of the flowing water. ii) Critical depth and critical velocity iii) Value of minimum specific energy.	BT-4	Analyse
8.	Derive the expressions for the most economical depths of flow in terms of the diameter of the channel of circular cross-section for maximum velocity and maximum discharge.	BT-3	Application
9.	In a rectangular channel 3.5m wide laid at a slope of 0.0036, uniform flow occurs at a depth of 2m. Find how high can the hump be raised without causing afflux? If the upstream depth of flow is to be raised to 2.5m, what should be the	BT-3	Application

	height of the hump? Take Manning"s n equal to 0.015.		
10.	A 3m wide rectangular channel carries a flow of 6 m³/sec. The depth of flow at a section P is 0.5m. A flat-toppedhump is to be placed at the downstream of the section P. Assume negligible energy loss between section P and hump, and consider g as 9.81 m/s². Find the maximum height ofthe hump (expressed in m) which will not change the depth of flow at section P.	BT-5	Evaluate
11.	The conjugate depths for hydraulic jump in a rectangular channel are 0.5 m and 2m respectively. Calculate the discharge for meter width. What is depth for which critical flow occurs. What is the energy loss? Draw a neat sketch of the flow pattern in the above hydraulic jump and find the power loss.	BT-4	Analyse
12.	Determine the height of a rectangular weir of length 6m to be built across a rectangular channel. The maximum depthof water on the upstream side of the weir is 1.8 m and discharge is 2000 litres/s. Take C_d = 0.6 and neglect end contractions.	BT-4	Analyse
13.	Find the discharge through a trapezoidal notch which is 1 m wide at the top and 0.40 m at the bottom and is 30cm in height. The head of water on the notch is 20cm. Assume C_d for rectangular portion = 0.62. while for triangular portion = 0.60	BT-3	Application
14.	Froude number before the jump is 10.0 in a hydraulic jump occurring in a rectangular channel and the energy loss is 3.20m. Discuss the (i) Sequent depths and (ii) The discharge	BT-4	Analyse
15.	Define parshall flume. Explain how to estimate the flow using the flume with a neat sketch also write about advantages and method of installation.	BT-3	Application
16.	(a) Determine the discharge of a stream having a cross-sectional area of 50 sq ft and a wetted perimeter of 16 ft, using the slope-area method. The difference in elevation of the water surface 500 ft apart is 0.3 ft. The channel has straight banks with some weeds. (b) Determine the discharge in a trapezoidal concrete-lined canal using the float method. The canal has a 1 ft bottom	BT-5	Evaluate

	width and 1:1 side slopes with a flow depth of 1.3 ft. The times for a float to travel 200 feet were 72, 79, 74, 76, and 79 seconds.		
17.	Explain in detail about how to measure the flow in the river using the float method.	BT-3	Application

UNIT V - DIMENSIONAL ANALYSIS

Dimensional analysis–Fundamental dimensions–dimensional homogeneity Rayleigh's method and Buckingham Pi-Theorem- concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber.

PART – A			
Q.No	Questions	BT Level	Competence
1.	Distinguish between model and prototype.	BT-2	Understand
2.	State the Buckingham's π-theorem	BT-2	Understand
3.	Define Similitude and Scale ratio	BT-1	Remember
4.	Explain about model and model analysis.	BT-1	Remember
5.	Explain the advantages of model testing.	BT-1	Remember
6.	Write short note on distorted model and undistorted model	BT-1	Remember
7.	Develop the expression for Froude number	BT-1	Remember
8.	Distinguish between Geometric similarity and Kinematic similarity.	BT-1	Remember
9.	State Mach's model law	BT-1	Remember
10.	Define the term model.	BT-1	Remember
11.	What are the methods of dimensional analysis?	BT-1	Remember
12.	List various model laws applied in model analysis	BT-2	Understand
13.	Write short note on Dynamic similarity	BT-2	Understand
14.	Examine whether the equation $V = \sqrt{2gH}$ is dimensionally homogenous.	BT-2	Understand
15.	Explain the term dimensional homogeneous equation.	BT-2	Understand
16.	Define the term prototype	BT-1	Remember
17.	Define model analysis	BT-2	Understand
18.	Define hydraulic similitude.	BT-1	Remember
19.	What is the use of distorted models?	BT-1	Remember
20.	What do you mean by repeating variables?	BT-2	Understand
21.	What do you mean by fundamental units?	BT-1	Remember
22.	What do you mean by derived units?	BT-2	Understand

23.	What is meant by dynamic similarities?	BT-1	Remember
24.	Write the scale ratio for velocity.	BT-1	Remember

PART-B

1.	Find an expression for the drug force of smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density p and dynamic velocity μ.	BT-5	Evaluate
2.	The pressure drop in a pipe of diameter D and length l depends on mass density p and viscosity μ of the flowing fluid, mean velocity of flow V and average height k of roughness projections on the pipe surface. Obtain a dimensionless expression for pressure drop Δp. Hence show that $h_f = \dfrac{flV^2}{2gD}$ where h_f is the head loss due friction $(\dfrac{\Delta p}{w})$, w is the specific weight of the fluid and f is coefficient of friction	BT-3	Application
3.	A pipe of diameter 1.5 m is required to transport an oil of sp. gr. 0.90 and viscosity $3 * 10^{-2}$ poise at the rate of 3000 litre/s. Tests were conducted on a 15 cm diameter pipe using water at $20^oC = 0.01$ poise.	BT-3	Application
4.	The efficiency of a fan depends upon density, dynamic viscosity of fluid, angular velocity, diameter of the rotor and the discharge. Using Buckingham pi theorem express efficiency in terms of dimension less parameters.	BT-3	Application
5.	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain an expression for Δp.	BT-4	Analyse
6.	The ratio of lengths of a sub-marine and its model is 30: 1. The speed of sub-marine (prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag(resistance) between the model and its prototype. Take the value of kinematic viscosities for sea water and air as 0.12 stokes and 0.16 stokes respectively. The density for sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.	BT-3	Application

7.	A 7.2 m height and 15 m spillway discharge 94 m³/s discharge under a head of 2.0 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 experiences of force of 7500 N (764.53 kgf) determine force on the prototype.	BT-4	Analyse
8.	A 1: 15 model of a flying boat is towed through water. The prototype is moving in sea water of density 1024 kg/m³ at a velocity of 20 m/s. Find the corresponding speed of the model. Also determine the resistance due to waves on model if the resistance due to waves of prototype is 600 N.	BT-5	Evaluate
9.	a) Find the expression for the power p, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid. b) The efficiency η of fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and discharge Q. Express η in terms of dimensionless parameter	BT-4	Analyse
10.	Berifly explain the step-by-step procedure for solving the problem by using Buckingham's π – theorem with an example.	BT-3	Application
11.	The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho \Phi \left[\frac{\mu}{D^2 N \rho}\right]$.	BT-4	Analyse
12.	Show the ratio of inertia force to viscous force gives the Reynolds number.	BT-3	Application
13.	Explain briefly how models are tested for the partially sub-merged bodies.	BT-3	Application
14.	a) In 1 in 40 model of a spillway, the velocity and discharge are 2 m/s and 2.5 m³/s. Find the corresponding velocity and discharge in the prototype. b) In the model test of a spillway the discharge and velocity of flow over the model were 2 m³/s and 1.5 m/s respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size.	BT-4	Analyse
15.	Determine the dimensions of the quantities given below (i) Angular velocity, (ii) Angular acceleration, (iii) Discharge, (iv)	BT-4	Analyse

	Kinematic viscosity, (v) Force, (vi) specific weight and (vii) Dynamic viscosity.t		
16.	Find an expression for the drag force on smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density ρ and dynamic viscosity μ.	BT-5	Evaluate
17.	a) The discharge through a weir is 1.5 m^3/s. Find the discharge through the model of the weir if the horizontal dimensions of the model $= \frac{1}{50}$ the horizontal dimension of the prototype and vertical dimension of the model $= \frac{1}{10}$ the vertical dimensions of the prototype. b)Explain about the Euler's model law and weber's model law.	BT-4	Analyse