SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTUREENGINEERING

QUESTION BANK

III SEMESTER

1902302–FLUID MECHANICS AND HYDRAULICS

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Prepared by

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SUBJECT: 1902302– FLUID MECHANICS AND HYDRAULICS

SEM / YEAR: III/II

UNIT I - PROPERTIES OF FLUID

Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity - surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy- metacentre – metacentric height.

PART – A

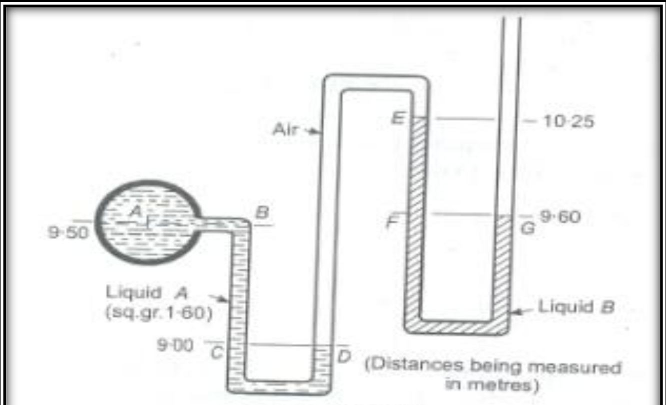
Q.No	Questions	BT Level	Competence
1.	Distinguish between gauge pressure and vacuum pressure	BT-3	Application
2.	Write down the expression for capillary fall in terms of surface tension	BT-1	Remember
3.	Explain Newton"s Law of Viscosity.	BT-2	Understand
4.	Classify the Types of fluids	BT-3	Understand
5.	What are the properties of real fluid?	BT-2	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 b/w statics and kinematics.	BT-3	Application
17.	Give the difference between liquid and gas.	BT-3	Application
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-3	Application
19.	Differentiate fluid and solid.	BT-2	Understand
20.	State Archimedes principle.	BT-1	Remember
21	Write the value of specific gravity and density of water and mercury.	BT-4	Analyse
22	State pascal's law	BT-1	Remember
23	What is manometric liquid and where it is used?	BT-2	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-3	Application
25	Temperature rise, decreases viscosity in liquids but increases in gases, why?	BT-3	Application

PART - B

1.	a. Calculate the specific weight, density and specific gravity of one litre of a liquid, which weighs 7N. b. Calculate the density, specific weight and weight of one litre of petrol of specific gravity = 0.7	BT-3	Application
2.	The space between two parallel horizontal plates is kept 5 mm apart. This is filled with crude oil of dynamic viscosity 2.5 kg-s/m^2. If the lower plate is stationary and the upper plate is pulled with velocity of 1.75 m/s, determine the shear stress on the lower plate	BT-3	Application
3.	The space between two parallel plates 4 mm apart is filled with an oil of specific gravity 0.85. The upper plate of area 600 cm^2 is dragged with constant velocity of 0.75 m/s by applying a force of 0.2 kgf to it. Assume straight line velocity	BT-3	Application

	distribution and calculate velocity gradient, dynamic viscosity of oil in poise and kinematic viscosity of oil in stokes		
4.	What do you mean by viscosity?. Velocity distribution of a fluid of dynamic viscosity 8.63 poise is $u = 2/3y - y^2$ in which u is the velocity in m/sec at a distance meter above the plate. Determine the shear stress at y = 0 and y = 1.5m	BT-1	Remember
5.	A plate with surface area of 0.4 m^2 and weight of 500 N slides down on an inclined plane at 30^0 to the horizontal at a constant speed of 4 m/s. If the inclined plane is lubricated with an oil of dynamic viscosity 2 poises, find the thickness of lubricant film.	BT-2	Understand
6.	A vertical gap 23.5 mm wide of infinite extent contains oil of specific gravity 0.9 and viscosity 2.5 N-s/m^2. A metal plate 1.5m * 1.5m * 1.5mm weighing 50N is to be lifted through the gap at a constant speed of 0.1 m/sec. Estimate the force required to lift the plate.	BT-3	Application
7.	An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200 r.p.m. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil film is 1.0mm	BT-3	Application
8.	Explain the three conditions of equilibrium developed when a floating body is given a sight angular displacement.	BT-2	Understand
9.	Derive an expression for the pressure inside a droplet, hollow bubble and a free jet.	BT-2	Understand
10.	Explain about different types of manometer in detail	BT-2	Understand
11.	For the gauge pressure of (-25960 N/m^2) at A. Determine the specific gravity of the gauge liquid B as shown in fig.	BT-3	Application

	 Figure Ex. 2.14		
12.	a. A circular plate of 3.0m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of centre of pressure b. A metallic cube 30cm side and weighing 45 N is lowered into a tank containing a two fluid layer of water and mercury. Top edge of the cube is at water surface. Determine the position of block at water-mercury interface when it has reached equilibrium.	BT-3	Application
13.	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 * 1 m * 0.8 m.	BT-3	Application
14.	a. A rigid steel container is partially filled with a liquid at 15 atm. The volume of the liquid is 1.232 L. At a pressure of 30 atm, the volume of the liquid is 1.231 L. (Atmosphere pressure = 101.3 kPa). What is the bulk modulus of elasticity (K) of the liquid over the given range of pressure? And what is the coefficient of compressibility? b. The velocity distribution in m/s near the solid wall at a section is a laminar flow is given by $u = 5 \sin(\pi y)$. If $\mu = 5$ poise. Find the shear stress at $y = 0.05$m in N/m^2.	BT-3	Application

PART - C

1.	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-1	Remember
2.	Explain different pressure measuring devices.	BT-2	Understand
3.	Explain the characteristics of Newtonian and non-Newtonian fluids in detail	BT-2	Understand
4.	Through a very narrow gap of height h, a thin plate of large extent is pulled at a velocity V. On one side of the plate is oil of viscosity μ_1 and on theother side of oil of viscosity μ_2. Calculate the position of the plate so that (i) the shear force on the two sides of the plate is equal; (ii) the pull required to drag the plate is minimum.	BT-3	Application

UNIT II - FLUID FLOW ANALYSIS

Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube path line – 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.

PART – A

Q.No	Questions	BT Level	Competence
1.	Classify the types of Motion	BT-2	Understand
2.	What do you understand from Continuity Equation?	BT-4	Analyse
3.	List the properties of potential function	BT-1	Remember
4	Write the integral form of momentum equation	BT-3	Application
5.	What do you infer from vorticity?	BT-5	Evaluate
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-3	Application
17.	Derive the continuity equation.	BT-3	Application
18.	Distinguish between stream line and streak line.	BT-3	Application
19.	Outline the expression for Circulation.	BT-4	Analyse
20.	Distinguish between uniform and non-uniform flow	BT-4	Analyse
21	What is stream tube path line?	BT-4	Analyse
22	Write and infer the equations of motion	BT-5	Evaluate
23	Define circulation and write its expressions	BT-5	Evaluate
24	Illustrate the equation for acceleration of flow of fluid.	BT-6	Create
25	Write Euler‟sequation.	BT-6	Create

PART– B

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-1	Remember
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-1	Remember
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-1	Remember
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-1	Remember

5.	The stream function Ψ = 4xy in which y is in cm^2/sec and x and y are in meters describe the incompressible flow between the boundary shown below. Calculate a) Velocity at B. b) Convective acceleration at B. c) Flow per unit width across AB.	BT-2	Understand
6.	The velocity components of the two dimensional plane motion of a fluid are u = $\frac{y^2-x^2}{(x2+y2)^2}$ and v = $\frac{-2xy}{(x2+y2)^2}$.Show that the fluid is incompressible and flow is iirotational	BT-2	Understand
7.	a) A stream function is given by Ψ = $3x^2 - y^3$. Determine the magnitude of velocity components at the point (2, 1). b) A stream function in a two dimensional flow is Ψ = 2xy. Show that the flow is irrotational and determine the corresponding velocity potential Φ.	BT-2	Understand
8.	A ripple 200 m long slop down at 1 in 100 and taper from 600 mm diameter at the higher end to 300 mm diameter at the lower end, and carries 100 litres/ sec of oil having specified gravity 0.8. If the pressure gauge at the higher end reads 60 kN/m2, determine the velocities at the two ends and also the pressure at the lower end	BT-3	Application
9.	Explain about principle of conservation of mass and momentum	BT-3	Application
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-3	Application
11.	For a two dimensional irrotational flow, the velocity potential is defined as Φ = $\log_e(x^2 + y^2)$. Find the possible stream function(Ψ) for this flow.	BT-4	Analyse
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	Analyse

13.	a) The velocity in m/s at appoint in a two dimensional flow is given as V = 3i + 5j. Find the equation of the stream line passing through the point (x, y). b) In a 2m long tapered duct, the area is function of x and decreases as A_x = (0.4 – 0.1x) where x is distance in meters measured from the lef end of the duct. It was found to increase discharge at the rate of increase discharge at the rate of 0.12 $m^3/s/s$. Find the local acceleration in m/s^2 at x = 2m.	BT-5	Evaluate
14.	In a certain 2 – D potential flow the streamline passing through a point A = (1, 1) has the following equation xy =1. Find the equation of the equipotential line passing through A.	BT-6	Create

PART - C

1.	Derive Euler equation of motion	BT-3	Application
2.	Derive 3D continuity equation in differential form	BT-2	Evaluate
3.	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	BT-1	Remember
4.	(i) If for a two – diamantine potential flow, the velocity potential is given by ϕ = x (2y −1) determine the velocity at the point P(4,5). Determine also the value of stream function Ψat the point P. (ii) Briefly describe about velocity potential function and stream function	BT-5	Evaluate

UNIT III - FLOW MEASUREMENT

Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter - rotameter – elbow meter - pitot tube – 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 – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen- William‟ s formula -

Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves

PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define Reynolds number	BT-3	Application
2.	Name the characteristics of laminar flow	BT-2	Understand
3.	Analyze pipe in series	BT-4	Analyze
4.	Formulate equation of head loss due to friction.	BT-5	Evaluate
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-1	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-3	Application
17.	Derive an expression for Chezys formula.	BT-3	Application
18.	Classify flow based on Reynolds number.	BT-3	Application
19.	Write about HazensWillams equation.	BT-4	Analyse
20.	Illustrate about time for empty of tank	BT-4	Analyse
21	Enumerate an expression for mannings formula	BT-4	Analyse
22	Give the relation between friction and chezys constant.	BT-5	Evaluate
23	Formulate Hagen Poisuille"s equation.	BT-5	Evaluate
24	What are the effect observed due to sudden closure of value in pipe flow?	BT-6	Create
25	Sketch velocity and shear stress distribution over length of pipe	BT-6	Create

PART - B

1.	a) A 0.25m diameter pipe carries oil of specific gravity 0.8 at the rate of 120 litres per second and the pressure at a point A is 19.62 kN/m^2(gage). If the point A is 3.5m above the datum line, calculate the total energy at point A in meters of oil. b) Water (γ_w = 9.879 kN/m^3) flows with flow rate of 0.3 m^3/sec through a pipe AB of 10 m length and of uniform cross section. The end B is above end A and the pipe makes an angle of 30^0 to the horizontal. For a pressure of 12 kN/m^2 at the end B, Find the corresponding pressure at the end A.	BT-1	Remember
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-1	Remember
3.	A straight pipe AB of length 10m, tapers from a diameter of 40 cm at A to 20 cm at B. . The centre line of the pipe is so located that the end B is 2m above the level of A. Liquid of specific gravity 0.9 flows through the pipe at 150 litres/sec. Pressure gauges connected at A and B show the reading of 60 kPa and 40 kPa, respectively. Determine the direction of flow	BT-1	Remember
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 of specific 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-1	Remember
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-2	Understand
6.	Water flows at the rate of 0.147m^3/s through a 150mm	BT-2	Understand

	diameter orifice inserted in a 300mm diameter pipe. If the pressure gages fitted upstream and downstream of the orifice plate have shown readings of 176.58 kN/m^2 and 88.29 kN/m^2 respectively. Find the coefficient of discharge C of the orifice meter.		
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 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.	BT-2	Understand
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) Find the discharge through a totally droened orifice 2.0m wide and 1m deep, if the difference of water levels on both the sides of the orifice be 3m. Take C_d = 0.62	BT-3	Application
10.	Derive Darcy Equation for the loss of head due to friction in pipes.	BT-2	Understanding
11.	A horizontal pipe of diameter 60mm is subjected to an oil flow at the rate of 6.36 liter/sec. The mass density and viscosity of oil 900 kg/m^3 and 0.9 Pa-sec respectively. The length of the pipe is 100m. Determine the following, a) Pressure drop b) Shear stress at the boundary of the pipe c) Power required to maintain the oil flow d) Velocity at 8mm from the pipe wall surface	BT-4	Analyse
12.	Water discharged from a tank maintained at a constant head	BT-4	Analyse

	at 5m above the exit of a straight pipe 100m long 150mm diameter. Estimate the rate at flow if the friction factor for the pipe is given as 0.01. Minor losses are accounted.		
13.	Describe an orifice meter and find an expression for measuring discharge through a pipe with this device.	BT-2	Understanding
14.	A pipe of 0.7 m diameter has a length of 6km and connects two reservoirs A and B. The water level in reservoir A is at an elevation 30 m above the water level in reservoir B. Halfway along the pipeline, there is a branch through which water can be supplied to a third reservoir C. The friction factor of the pipe is 0.024. The quantity of water discharged into reservoir C is $0.15 m^3/s$. Considering the acceleration due to gravity as $9.81 m/s^2$ and neglecting minor losses, Find the discharge (in m^3/s) into the reservoir?	BT-6	Create

PART - C

1.	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-4	Analyse
2.	Describe about flow measuring devices.	BT-2	Understand
3.	The inlet and throat diameter of a horizontal venturimeter are 30cm and 10 cm respectively. The Liquid flowing through the meter is water. The pressure intensity at inlet is 13.734 N/cm2. While the vacuum pressure head at the throat is 37cm of mercury. Find the rate of flow. Assume that 4% of the differential head is lost between the inlet and throat. Find also the value of Cd for the venture meter.	BT-1	Remember
4.	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 at the pressure at the lower end	BT-6	Create

	if the pressure at the higher level is 19.62 N/m2		

UNIT IV - OPEN CHANNEL FLOW

Types of flow in channel – uniform flow – most economicalsection of channel – rectangular – trapezoidal. Specific energy and critical depth -- momentum in openchannel flow – specific force – critical flow – computation. Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement inrivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume

PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Differentiate afflux and backwater curve.	BT-4	Analyse
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-3	Application
5.	Define hydraulic mean depth.	BT-6	Create
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-2	Understand
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-3	Application

17.	State the condition for efficient rectangular section.	BT-3	Application
18.	Write the condition for efficient circular section.	BT-3	Application
19.	Find the critical height for a trapezoidal section.	BT-4	Analyse
20.	What is specific energy and what is the condition for getting only one depth for a given specific energy?	BT-4	Analyse
21	Define and distinguish between steady flow and unsteady flow.	BT-4	Analyse
22	Compute the hydraulic mean depth of a small channel of 1m wide and 0.5m deep with water flowing at 2m/s.	BT-5	Evaluate
23	Differentiate closed conduit flow and open channel flow.	BT-5	Evaluate
24	Outline different types of notches	BT-6	Create
25	Enumerate the use of current meter.	BT-6	Create

PART - B

1.	Determine the most efficient section of a trapezoidal channel with 'n' = 0.025 to carry a discharge of 15 m^3/sec to 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-1	Remember
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 is to 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-1	Remember
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-1	Remember
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-1	Remember
5.	A trapezoidal channel, shown in the fig carries a water	BT-2	Understand

	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.		
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-2	Understand
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-2	Understand
8.	a) What are the different tyes of flow in the channel? Explain with an example. b) what is specific energy curve ?Derive the expression for the critical depth and critical velocity.	BT-2	Understand
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 height of the hump? Take Manning's n equal to 0.015.	BT-3	Application
10.	A 3m wide rectangular channel carries a flow of 6 m^3/sec. The depth of flow at a section P is 0.5m. A flat-topped hump 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/s^2. Find the maximum height of the hump (expressed in m) which will not change the depth of flow at section P.	BT-3	Application
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	BT-4	Analyse

	the flow pattern in the above hydraulic jump and find the power loss.		
12.	Determine the height of a rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of 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-5	Evaluate
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-6	Create

PART - C

1.	Prove that half of the top width of a most economical trapezoidal section is equal to the length of the one of the side slopes and derive the hydraulic mean depth as half of the depth of the flow.	BT-4	Analyse
2.	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-2	Understand
3.	Uniform flow occurs at a depth of 1.50m in a rectangular channel 3 m wide and laid to a slope of 0.0009.If Manning n = 0.015, calculate, i) maximum height of hump on the floor to produce critical depth ii) Maximum height of hump so that upstream depth will not be affected iii) The width of contraction width will produce	BT-1	Remember

	critical depth without increasing the upstream depth of flow.		
4.	A 8 m wide channel conveys 15 cumecs of water at a depth of 1.2 m.Determine Specific energy of the flowing water, Critical depth, Critical velocity, Minimum Specific energy, Froude number and also state whether the flow is sub critical or super critical.	BT-6	Create

UNIT V - DIMENSIONAL ANALYSIS & PUMPS

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 - Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves. Turbine and submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump- Hydraulic ram

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-3	Application
3.	Define Similitude and Scale ratio	BT-4	Analyse
4.	Explain about model and model analysis.	BT-6	Create
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.	Write the dimensional unit of power.	BT-1	Remember
11.	Write about negative slip. How does it occur?	BT-1	Remember
12.	List various model laws applied in model analysis	BT-2	Understand
13.	Develop the equation for specific speed for pump	BT-2	Understand

14.	Define specific speed of pump.	BT-2	Understand
15.	Mention the main parts of centrifugal pump.	BT-2	Understand
16.	Write short note on Dynamic similarity	BT-3	Application
17.	Enumerate about cavitation in pumps.	BT-3	Application
18.	Outline priming of pumps.	BT-3	Application
19.	List the types of impellers and casing for a centrifugal pump.	BT-4	Analyse
20.	Mention the main components of reciprocating pump.	BT-4	Analyse
21	What do you infer from Head of a pump?	BT-4	Analyse
22	What is net positive suction head in a centrifugal pump?	BT-5	Evaluate
23	Examine whether the equation $V = \sqrt{2gH}$ is dimensionally homogenous.	BT-5	Evaluate
24	What is the role of a volute chamber of a centrifugal pump?	BT-6	Create
25	Enumerate the Difference between pump and turbine.	BT-6	Create

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-1	Remember
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 $h_f = \frac{flV^2}{2gD}$ where h_f is the head loss due friction $(\frac{\Delta p}{w})$, 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.	Estimate for 1:20 model of a spillway i) prototype velocity corresponding to a model velocity of 2 m/s. ii) prototype discharge per unit width corresponding to a model discharge per unit width of 0.3 m^3/s/m. iii) pressure head in the prototype corresponding to a model head of 5 cm of mercury at a point iv) the energy dissipated per second in the model corresponding to a prototype value of 1.5 kW	BT-3	Application
6.	The pressure drop in an aeroplane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Find 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.	BT-3	Application
7.	The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400 mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at inlet an outlet are 20^0 and 30^0 respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.	BT-3	Application
8.	A centrifugal pump is to discharge 0.118 m^3 at a speed of 1450 r.p.m against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	BT-3	Application
9.	The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width is 50 mm. The pump is running at 800 r.p.m. and is working against a total head of 15m. The vanes angle at outlet is 40^0 and manometric efficiency is 75%. Determine i) velocity of flow at outlet ii) velocity of water leaving the vane. iii) angle made by the absolute velocity at outlet with the direction of motion at outlet, and iv) discharge.	BT-3	Application
10.	A one-fifth scale model of a pump was tested in a labouratory at 1000 r.p.m. The head developed and the power input at the best efficiency point were found to be 8 m and 30 kW respectively. If the prototype pump has to work against a head	BT-3	Application

	of 25 m, determine its working speed, the power required to drive it and the ratio of flow rates handled by the two pumps.		
11.	A single-stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 r.p.m and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75%. Find the number of stages and diameter of each impeller of a similar multistage pump to lift 5m^3 of water per second to a height of 200 metres when rotating 1500 r.p.m.	BT-4	Analyse
12.	Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 r.p.m. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m 3/s.	BT-4	Analyse
13.	A centrifugal pump rotating at 1000 r.p.m delivers 160 litres/s water against a head of 30m. The pump is installed at a place where atmospheric pressure is 1 * 10^5Pa(abs.). and vapour pressure of water is 3 kPa(abs.). The head loss in suction pipe is equivalent to 0.2 m of water, Calculate i) Minimum NPSH and ii) Maximum allowable height of the pump from free surface of water in the sump.	BT-5	Evaluate
14.	What is reciprocating pump? describe the working of the single and double acting reciprocating pump.	BT-2	Understand

PART - C

1.	Explain the working principle of multi stage centrifugal pump with a neat sketch.	BT-3	Analyse
2.	A centrifugal pump with an impeller diameter of 0.4 m runs at 1450 rpm. The angle at outlet of the backward curved vane is 25^0 with tangent. The flow velocity remains constant at 3 m/s. If the manometric efficiency is 84%, Determine the fraction of the kinetic energy at outlet recovered as static head.	BT-6	Create
3.	Define Similitude and discuss its type of similarities in detail.	BT-4	Remember
4.	A 7.2 m height and 15 m long spillway discharge 94 m3/s,	BT-2	Understand

	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 7500N, Calculate the force on the prototype.		

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SRM VALLIAMMAI ENGINEERING COLLEGE

DEPARTMENT OF AGRICULTURE ENGINEERING

Question Bank

1902302–FLUID MECHANICS AND HYDRAULICS

S.No	UNIT No.		BT1	BT2	BT3	BT4	BT5	BT6	Total Questions
1	Unit-1	Part-A	7	5	4	4	3	2	25
		Part-B	4	3	3	2	1	1	14
		Part-C	1	1	-	1	-	1	4
2	Unit-2	Part-A	7	5	4	4	3	2	25
		Part-B	4	3	3	2	1	1	14
		Part-C	1	1	1	-	1	-	4
3	Unit-3	Part-A	7	5	4	4	3	2	25
		Part-B	4	3	3	2	1	1	14
		Part-C	1	1	-	1	-	1	4
4	Unit-4	Part-A	7	5	4	4	2	3	25
		Part-B	4	3	3	2	1	1	14
		Part-C	-	1	1	1	-	1	4
5	Unit-5	Part-A	7	5	4	4	2	3	25
		Part-B	4	3	3	2	1	1	14

		Part-C	-	1	1	1	-	1	4

TOTAL NO. OF QUESTIONS IN EACH PART

PART-A	125
PART-B	70
PART-C	20
TOTAL	215