SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

IV SEMESTER

CE3462 - APPLIED HYDRAULIC ENGINEERING

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DEPARTMENT OFCIVIL ENGINEERING

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SUBJECT : CE3462 - APPLIED HYDRAULIC ENGINEERING

SEM / YEAR: IV/ II

UNIT I - UNIFORM FLOW

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Fundamental equations - Sub-critical, Super-critical and Critical flow - Velocity distribution in open channel - Steady uniform flow - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force, Weir and Notches - Types.

PART-A

1	Define open channel flow with example.	BT-1	Remembering
2	Define uniform flow in channels.	BT-1	Remembering
3	State the critical flow.	BT-1	Remembering
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	Remembering
5	Define hydraulic mean depth.	BT-1	Remembering
6	List the factors affecting Manning's roughness coefficient.	BT-1	Remembering
7	Classify the various types of flow in open channels.	BT-2	Understanding
8	What are the possible types of flow in open channel with respect to space and time?	BT-2	Understanding
9	What is specific energy and what is the condition for getting only one depth for a given specific energy?	BT-2	Understanding
10	Differentiate closed conduit flow and open channel flow.	BT-2	Understanding
11	Sketch the velocity distribution in rectangular and triangular channels.	BT-1	Remembering
12	What is meant by most economical section?	BT-1	Remembering
13	Write the Bazin's formula for the discharge in the channel.	BT-2	Understanding
14	Compare the prismatic channel with the non-prismatic channel.	BT-1	Remembering
15	Give the relationships between Chezy's 'C' and Manning's 'n'.	BT-2	Understanding
16	Define and distinguish between steady flow and unsteady flow.	BT-1	Remembering
17	Compute the hydraulic mean depth of a small channel of 1m wide and 0.5m deep with water flowing at 2m/s.	BT-2	Understanding
18	Derive the dimension of constant 'C' in chezy's formula.	BT-2	Understanding
19	Write the flow characteristics of open channel.	BT-2	Understanding
20	Write about non-erodible channels. What are the factors considered while designing non-erodible channels?	BT-2	Understanding
21	Compute the hydraulic mean depth of a small channel 1m wide, 0.5m deep with water flowing at 2m/s.	BT-1	Remembering
22	State the Kutter's formula for determining the Chezy's constant.	BT-1	Remembering
23	On what condition most economical trapezoidal channel section is	BT-2	Understanding

	derived?		
24	State the condition for maximum velocity and maximum discharge in circular channel.	BT-1	Remembering
25	State the Manning's formula for determining the Chezy's constant.	BT-1	Remembering

PART –B

1.	Calculate the specific energy of $12m^3/s$ of water flowing with a velocity of 1.5m/s in a rectangular channel 7.5m wide. Find the depth of water in the channel when the specific energy would be minimum. Identify the value of critical velocity as well as minimum specific energy?	BT-3	Applying
2.	If $y_1$and $y_2$are alternate depths in a rectangular channel memorize that $y_c^3 = (2y_1^2.y_2^2/(y_1+y_2)$ and hence the specific energy $E = (y_1^2 + y_1y_2 + y_2^2) / (y_1 + y_2)$.	BT-4	Analyzing
3.	A 3m wide rectangular channel conveys $12m^3$ of water at a depth of 2m.Find out Specific energy of flowing fluid, Critical depth, critical velocity and the minimum specific energy, Froude number and state whether the flow is sub-critical or super critical.	BT-3	Applying
4.	How the flows are classified under specific energy concepts? Find the discharge through a rectangular channel of width 6m, having a bed slope of 1 in 1000. The depth of flow is 4m. Use Chezy's formula, Take C=50.	BT-3	Applying
5.	Calculate the specific energy, critical depth and velocity of the flow of $10m^3/s$ in a cement lined rectangular channel 2.5m wide with 2m depth of water. Is the given flow subcritical or supercritical?	BT-4	Analyzing
6.	Derive the expression for most economical rectangular channel.	BT-4	Analyzing
7.	Derive chezy's formula for discharge through channel. Write the formula to find out the constant 'C'.	BT-4	Analyzing
8.	Calculate the critical depth corresponding to discharge of $7.5m^3/sec$ for the following cases. (a) Rectangular Channel of width 3m (b) Triangular channel with side slope 1 vertical 1.25 horizontal. (c) Trapizoidal channel of bottom width 2m side slope 1 vertical to 1.25 horizontal.	BT-3	Applying
9.	Determine the most economical section of rectangular channel carrying water at the rate of 400 litres/sec The bed slope of the channel is 1 in 2000. Assume Chezy's constant C=50.	BT-3	Applying
10.	A concrete lined circular channel of diameter 3m has a bed slope of 1 in 500. Work out the velocity and flow for conditions of Maximum velocity and Maximum discharge.	BT-4	Analyzing
11.	A trapezoidal channel with side slopes 1 to 1 has to be designed to carry $10m^3/s$ at a velocity of 2 m/s so that the amount of lining of concrete for bed and sides is minimum. Calculate the area of lining required for one meter length of the channel.	BT-4	Analyzing
12.	The trapezoidal section or channel has side slope 3H:4V and the slope of the bed is 1 in 2000. Find the optimum dimmensions of the	BT-4	Analyzing

	channel. The discharge in the channel is $0.5m^3$/sec. Chezy's Constant 'C'= 80		
13.	Find the rate of water through a V-Shaped Channel. Take the Value of C=55 and slope of bed 1 in 2000 and the angle as 60^0.	BT-3	Applying
14.	The specific energy for 5m wide rectangular channel is 4m. The discharge of water through the channel is 19cumecs. Determine the alternate depth of flow and corresponding Froude number and also state whether the flow is sub critical or super critical.	BT-3	Applying
15.	Find the velocity of flow and rate of flow of water through a rectangular channel of 8 m wide and 4.5 m deep, when it is running full. The channel is having bed slope of 1 in 1500. Assume Chezy's constant C=60.	BT-3	Applying
16.	A Channel of trapezoidal section with side slopes at 45^0 to the horizontal, conveys water at a depth of 0.75 m. Find the width of the base and the gradient of the bed to discharge 1.3 cumec with a mean velocity of flow of 0.9m/s. Assume Chezy's coefficient C=50	BT-4	Analyzing
17.	A channel of trapezoidal section has sides sloping at 60^0 with the horizontal and a bed slope of 1 in 600 conveys a discharge of 10 cumecs. Find the bottom width and the depth of flow for most economical section. Assume chezy's constant C=60	BT-4	Analyzing
18	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-3	Applying
19	(i) A trapezoidal channel has a bottom width of 6m and side slopes of 2H : 1V. When the depth of flow is 1.2m, the flow is $10m^3$/s. What is the specific energy of flow and critical depth?(8) (ii) Find the rate of flow and conveyance for a rectangular channel 7.5m wide for uniform flow at a depth of 2.25m. The channel is having bed slope as 1 in 1000. Take Chezy's constant C=55. (8)	BT-5	Evaluating
20	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 for maximum discharge.	BT-4	Analyzing
21	(i) The specific energy for a 3 m wide channel is 3 Nm. What is the maximum possible discharge in the channel? (8) (ii) Show that in a rectangular channel, maximum discharge occurs when the flow is critical for a given value of specific energy. (8)	BT-3	Applying
22	A trapezoidal channel to carry 150 m^3/min of water is designed to have the best section. Find the bottom width and depth if the bed slope is 1 in 1200, the side slope is at 45^0 and chezy's constant C=50.	BT-3	Applying

UNIT – II: VARIED FLOW

Dynamic equations of gradually varied flow- Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method - Change in Grades.

PART – A

1.	Define varied flow.	BT-1	Remembering
2.	Formulate the Dynamic equations of gradually varied flow	BT-2	Understanding
3.	Classify the surface profiles in channels.	BT-1	Remembering
4.	List the assumption made in the derivation of dynamic equation for gradually varied flow.	BT-1	Remembering
5.	Classify the channel bottom slopes.	BT-2	Understanding
6.	If the depth increases in the direction of flow what type of curve is formed?	BT-1	Remembering
7.	What is the nature of slope of the channel if critical depth line occurs above normal depth line?	BT-2	Understanding
8.	Distinguish between gradually varied flow and rapidly varied flow in open channel.	BT-2	Analyzing
9.	Differentiate afflux and backwater curve.	BT-2	Understanding
10.	Sketch the different zones of water surface profiles in critical and mild sloped channels.	BT-1	Remembering
11.	Write down the condition for mild slope and critical slope?	BT-1	Remembering
12.	Illustrate the methods used to determine the length of surface profile.	BT-2	Understanding
13.	Write the expression to determine the length of the backwater curve.	BT-2	Understanding
14.	Distinguish between draw down and back water curve.	BT-1	Remembering
15.	What is meant by standard step method?	BT-1	Remembering
16.	Write about drawdown curves.	BT-2	Understanding
17.	Give the formulas related to Direct Step Method.	BT-1	Remembering
18.	Show the various combinations of slopes and resulting GVF profiles.	BT-1	Remembering
19.	Define control section.	BT-1	Remembering
20.	What are the three methods to calculate Surface profiles in prismatic channel?	BT-1	Remembering
21.	Distinguish between normal depth and critical depth.	BT-2	Understanding
22.	Sketch S1 type surface profile.	BT-2	Understanding
23.	Write about the zones above the channel bottom.	BT-1	Remembering
24.	In what situation Non-uniform flow can occur.	BT-1	Remembering
25.	What is the formula for conveyance of channel?	BT-1	Remembering

PART –B

1.	Find the slope of the free water surface in a rectangular channel of width 20m, having depth of flow 5m. The discharge through the channel is 50cumecs. The bed slope of the channel is 1 in 4000. Assume Chezy's constant C as 60.	BT-4	Analyzing

2.	What are the assumption made in analysis of Gradually Varied Flow? Derive the dynamic equation of the GVF.	BT-4	Analyzing
3.	Classify the different surface profiles for the various bottom slope condition of a channels.	BT-3	Applying
4.	Determine the slope of the free water surface in a rectangular channel of width 20m, having depth of flow 5m. The discharge through the channel is 52 cumecs. The bed slope of the channel is 1 in 4000. Assume chezy's constant c as 60.	BT-3	Applying
5.	Explain the various types of channel slopes with neat sketches and also write down the various curves formed in each slope.	BT-4	Analyzing
6.	Briefly explain profile determination by numerical method.	BT-3	Applying
7.	Explain in details about Various combinations of slopes and the resulting GVF profiles with neat sketch.	BT-3	Applying
8.	A river 100m wide and 3m deep has stable bed and vertical banks with a surface slope of 1 in 3000. Estimate the length of backwater curve produced by an afflux of 2m. Assume Manning's n=0.035.	BT-4	Analyzing
9.	A triangular channel with apex angle 75^0 =2 θ carries a flow of $12m^3$/sec at a depth of flow 0.8m. If the bed slope is 0.009. Find the roughness coefficient of the channel.	BT-4	Analyzing
10.	A rectangular flume 2m wide discharge at the rate of $2m^3$/s, the bed slope of the flume is 1 in 2500. At a certain section, the depth of the flow is 1m. Examine the distance of the section downstream where the depth of flow is 0.9m. Solve by single step method. Assume N=0.014.	BT-4	Analyzing
11.	Explain in detail about Control section with neat sketches.	BT-3	Applying
12.	Define backwater curve. Also derive the expression for the length of backwater curve.	BT-4	Analyzing
13.	A trapezoidal channel of bed width 3 m and side slopes 1 V: 1.5 H is carrying a flow of 10 m^3/s at a depth of 1.5m under uniform flow condition. The longitudinal slope of the channel is 0.001. Calculate the Manning's roughness coefficient of the channel.	BT-3	Applying
14.	In a rectangular channel of bed width 0.5m a hydraulic jump occurs at a point where depth of flow is 0.15m and Froude number is 2.5.Determine the Critical Depth, Specific energy, Subsequent depth and loss of head or energy dissipation.	BT-4	Analyzing
15.	A rectangular channel 4m wide and bed slope 1 in 4000, conveys a discharge of 4.4 m^3/s. The depth of flow at section is 0.9m. How far upstream will the depth of flow will be 0.95m? Assume, n =0.012	BT-3	Applying
16.	A river of rectangular section, 15m wide has a bed slope of 1 in 12100. The normal depth of water is 2 m. A weir constructed in the river raises the water level to 3m just on its upstream side. Find the length of the curve if n=0.025 in the manning's formula.	BT-3	Applying
17.	A rectangular channel 10m wide carries a discharge of 30 cumec. It is laid at a slope of 0.0001. If at a section in the channel the depth is 1.6 m, how far upstream or downstream from the section will the depth be 2 m. Assume n=0.015.	BT-3	Applying
18.	Summarize the assumptions made in the derivation of the dynamic equation for gradually varied flow. Starting from the	BT-3	Applying

	first principles, derive equations for the slope of the water surface in gradually varied flow with respect to channel bed.		
19.	Categorize the flow profile by various numerical method.	BT-4	Analyzing
20.	Determine the length of the backwater curve passed by a afflux of 2m in a rectangular channel of width 40m and depth 2.5m. The slope of the bed is given as 1 in 11000. Take Manning's N=0.03.	BT-4	Analyzing
21.	How dynamic equation of gradually varied flow is simplified in wide rectangular channel.	BT-3	Applying
22.	Write the procedure for direct step method and standard step method for computation of GVF.	BT-2	Understanding

UNIT – III: RAPIDLY VARIED FLOW

Application of the momentum equation for rapidly varied flow - Hydraulic jumps - Types - Energy dissipation – Celerity - Positive and Negative surges.

PART - A

1.	What are surges in an open channel flow? State the types.	BT-1	Remembering
2.	Define : Impulse momentum principle.	BT-1	Remembering
3.	State the flow conditions for the occurrence of hydraulic jump.	BT-1	Remembering
4.	Define celerity of surge.	BT-1	Remembering
5.	List the assumptions made in the analysis of hydraulic jump using the momentum equation.	BT-1	Remembering
6.	What is the cause of surge to occur in a flow?	BT-1	Remembering
7.	Why momentum equation only used for rapidly varied flow problems.	BT-2	Understanding
8.	Describe the rapidly varied flow with example.	BT-2	Understanding
9.	What is meant by energy dissipation?	BT-2	Understanding
10.	What are the classifications of hydraulic jump?	BT-2	Understanding
11.	What are the applications of momentum equation for RVF?	BT-1	Remembering
12.	Describe the uses of formation of hydraulic jump in a channel.	BT-2	Understanding
13.	What is meant by positive surge?	BT-1	Remembering
14.	Write the head loss equation for Hydraulic jump.	BT-2	Understanding
15.	Differentiate the positive and negative surges?	BT-1	Remembering
16.	Justify the transition in open channel.	BT-1	Remembering
17.	Write down the application of transition.	BT-2	Understanding
18.	What is the state of flow after formation of a hydraulic jump?	BT-1	Remembering
19.	Discuss about the negative surge.	BT-1	Remembering
20.	Write the ranges of Froude number before and after the hydraulic jump?	BT-2	Understanding
21.	State Newton's Second Law of motion.	BT-1	Remembering
22.	Give the applications for Hydraulic jump.	BT-2	Understanding
23.	How to find the length of the hydraulic jump?	BT-1	Remembering
24.	What is the formula to find the height of hydraulic jump?	BT-2	Understanding
25.	Find an expression for loss of energy head for a hydraulic jump.	BT-1	Remembering

PART – B

1.	In a rectangular channel of bed width 0.5 m, a hydraulic jump occurs at a point where depth of flow is 0.15 m and Froude's number is 2.5. Calculate The specific energy,The critical depth, The subsequent depths, Loss of head and Energy dissipated.	BT-3	Analyzing
2.	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	Analyzing
3.	A rectangular channel 6m wide discharge 1200 litres/sec of water into a 6m wide apron with no slope and with a mean velocity of 6m/s. what is the height of the jump? How much energy is absorbed in the jump?	BT-3	Analyzing
4.	The depth of flow of water at a certain section of rectangular channel 2m wide is 0.3 m. The discharge through a channel is 1.5 m^3/s. Determine whether a hydraulic jump will occur, if so, determine its height and loss of energy per kg.of water.	BT-4	Analyzing
5.	What is transition? How transitions are made in open channel? Also give its applications.	BT-3	Applying
6.	During an experiment conducted on a hydraulic jump, in a rectangular open channel 0.5m wide, the depth of water changes from 0.2m to 0.5m. Determine the discharge in the channel and the loss of head due to the formation of hydraulic jump.	BT-3	Analyzing
7.	Define surges. What are its types? How the energy dissipated? Explain in detail.	BT-4	Analyzing
8.	Explain the classification of hydraulic jumps. Write the expression for depth of hydraulic jump.	BT-4	Analyzing
9.	A control sluice spanning the entry of a 3.0m wide rectangular channel having mild slope admit $16m^3/s$ at a velocity of 4m/s. find whether a hydraulic jump is expected in the channel downstream from the sluice.	BT-3	Analyzing
10.	A horizontal rectangular channel 4m wide carries a discharge of $16m^3/sec$. Determine whether a jump may occur at an initial depth of 0.5m or not? Determine the sequent depth to this initial depth. Also determine the energy lost in the jump.	BT-3	Analyzing
11.	A rectangular channel carrying a supercritical flow is to be provided with a hydraulic jump type of energy dissipater. Energy loss required in the hydraulic jump is 5m and inlet Froude number is 8, determine the sequent depths.	BT-4	Analyzing
12.	Show that the loss of energy in a hydraulic jump, where y_1 and y_2 are the two conjugate depth. $\Delta E = (y_2-y_1)^3 / 4\, y_1 . y_2$	BT-3	Applying
13.	In a rectangular channel given the discharge intensity q=1.50 cumecs/m and the loss of energy in the jump h_L=2m, determine the two sequent depths.	BT-4	Analyzing
14.	A hydraulic jump occurs in a rectangular channel and the depths of flow before and after the jump are 0.45m and 1.8m respectively. Calculate the critical depth of flow.	BT-3	Analyzing

15.	In a horizontal rectangular channel velocity of flow is 12m/s and depth of flow is 1 m before the jump. Determine the depth of flow after the jump and loss of energy due to jump.	BT-3	Applying
16.	At the foot of a 30m wide spillway from a dam where the discharge velocity is 28.2 m/s and the depth is 0.96 m, a hydraulic jump is formed on a horizontal apron. Calculate the height of the jump and the total power dissipated in it.	BT-3	Applying
17.	A rectangular channel 3 m wide is carrying 5.7 m^3/s of water at a velocity of 6.5 m/s discharges into a channel where a hydraulic jump is obtained. What is the height of the jump and critical depth?	BT-3	Applying
18.	What is a hydraulic jump? List the assumptions made in the analysis of hydraulic jump. Explain its classification.	BT-3	Applying
19.	A venturiflume is 1.20m wide at entrance and 0.60m in the throat. Neglecting hydraulic losses in the flume, calculate the flow if the depths at the entrance and throat are 0.65m and 0.60m respectively. A hump is now installed at the throat, of height 20cm, so that a standing wave (Hydraulic jump) is formed beyond the throat. What is the increase in upstream depth when the same flow as before passes through the flume?	BT-4	Analyzing
20.	A spillway discharges a flood flow at a rate of 7.75 cumecs/m width. At the downstream horizontal apron the depth of flow was found to be 0.5 m. What tail water depth is needed to form a hydraulic jump? If a jump is formed, examine its type, length, head loss and energy loss as a percentage of the initial energy.	BT-3	Applying
21.	A rectangular channel 2m wide has a flow with a velocity 2m/sec and depth of flow 1.25m. The rate of flow at the downstream end is suddenly decreased. Such that the depth of flow is increased to 2m. Find the absolute velocity (celerity)'c' of the resulting surge and new discharge.	BT-4	Analyzing
22.	A trapezoidal channel having bottom width 8 m and side slope 1H:1V, carries a discharge of 80 cumec. Find the conjugate to initial depth of 0.75 m before the jump. Also determine the energy loss of the jump.	BT-3	Applying

UNIT – IV: TURBINES

Impact of Jet on flat, curved plates, Stationary and Moving - Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed – Minimum Speed to start the pump.

PART – A

1.	What is hydraulic turbine?	BT-1	Remembering
2.	A jet of water 40mm diameter with a velocity 30 m/strikes a stationary plate at its normal direction. Determine the force exerted by the jet.	BT-1	Remembering
3.	Define hydraulic efficiency	BT-1	Remembering
4.	Define specific speed and unit quantities of the turbine.	BT-1	Remembering
5.	State the impulse momentum equation.	BT-1	Remembering
6.	Define cavitation	BT-1	Remembering

7.	What is meant by penstock in a pelton wheel turbine?	BT-2	Understanding
8.	Describe the impulse turbine with example.	BT-2	Understanding
9.	What is reaction turbine? Give example.	BT-2	Understanding
10.	Write the types of draft tube.	BT-2	Understanding
11.	What are the applications of momentum principle?	BT-1	Remembering
12.	Classify hydraulic turbines.	BT-1	Remembering
13.	What are the uses of draft tubes	BT-1	Remembering
14.	Differentiate the impulse and reaction turbine.	BT-2	Understanding
15.	What are the types of turbine according to direction of flow through runner?	BT-2	Understanding
16.	Differentiate the inward flow reaction turbine and outward flow reaction turbine.	BT-1	Remembering
17.	Why draft tubes not used in impulse turbines?	BT-1	Remembering
18.	Write the function of draft tube in turbine outlet.	BT-2	Understanding
19.	What is the purpose of providing casing in turbine?	BT-1	Remembering
20.	Write about governing of turbines?	BT-2	Understanding
21.	Define mechanical efficiency.	BT-1	Remembering
22.	State overall efficiency.	BT-1	Remembering
23.	Differentiate between radial and axial flow turbines.	BT-2	Understanding
24.	Write the formula for discharge through reaction turbine.	BT-1	Remembering
25.	Define specific speed of pump.	BT-1	Remembering

PART – B

1.	A pelton wheel working under a head of 500m produces 13000kw at 430rpm. If the efficiency of the wheel (turbine) is 85%. Determine discharge of the turbine, diameter of the runner wheel and diameter of the nozzle. Assume suitable data.	BT-4	Analyzing
2.	A Pelton wheel is designed for the following specification. Shaft power = 11712kw, Head H=380m, Speed N=750rpm overall n_o=86% diameter of the nozzle not to exceed $(1/6)^{th}$ of the wheel dia. Determine Wheel diameter, Diameter of jeet, Number of jets required. Assume coefficient of velocity C_v=0.985, Speed ratio=0.45.	BT-3	Applying
3.	Two jets strike the buckets of a Pelton wheel is having shaft power 15450kw. The diameter of jet (d) =200mm. If net head of the turbine is 400m. Find the overall efficiency.	BT-4	Analyzing
4.	A inward flow reaction turbine has inlet (external) and outlet (internal) diameters as 1.2m and 0.6m respectively. The breadth at inlet is 0.25m and 0.35m at outlet at a speed of rotation of 250rpm. The relative velocity at the entrance is 3.5m/s and radial. Calculate Absolute velocity at entrance and inclination to the tangent of the runner, Discharge and Velocity of flow at Outlet.	BT-3	Applying

5.	A Francis turbine has an inlet diameter of 2m and outlet diameter 1.2m. The breadth of the blades is constant at 0.2m. The breadth of the blades is constant at 0.2m. The runner rotates at a speed of 250rpm with a discharge $8m^3$/Sec. The Vanes are radial at inlet and the discharge is radially outward at outlet. Calculate Angle of guide Vane at inlet (α), Blade angle at outlet (ϕ).	BT-4	Analyzing
6.	(i)Classify the turbines based on : (6) 1. Action of water on turbine blades 2. Head on turbine 3. Direction of flow through turbine runner 4. Specific speed 5. Disposition of turbines shaft (ii) Distinguish between impulse turbine and reaction turbine.(7)	BT-4	Analyzing
7.	The external and internal diameter of an inward flow reaction turbine are 1.2m and 0.6m respectively. The head on the turbine is 22m and the velocity of the flow through the runner is constant is equal to 2.5m/sec. the guide blade angle is given as 10^0 and the runner vanes are radial at inlet. If the discharge at outlet is radial determine speed of the turbine, the vane angle at the outlet of the runner and the hydraulic efficiency.	BT-3	Applying
8.	A jet of water 30mm diameter strikes a hinged square plate at its centre with a velocity of 20m/s. The plate is deflected through at an angle of 20˚. Calculate the weight of the plate and If the plate is not allowed to swing, what will be the force required to the lower edge of the plate to keep the plate in vertical position?	BT-3	Applying
9.	An inward flow reaction turbine is supplied water at the rate of 0.60 cumecs at a velocity of flow of 6 m/s. The velocity of periphery and velocity of whirl at inlet is 24 m/s and 18 m/s respectively. Assuming the discharge to be radial at outlet and Velocity of flow to be constant, determine the Vane angle at inlet and Head of water on the wheel	BT-3	Applying
10.	A Pelton wheel is to develop 13250 kW under a net head of 800m, while running at a speed of 600 rpm. If the coefficient of the jet is 0.97, speed ratio is 0.46, jet diameter is 1/15 of wheel diameter. Assuming overall efficiency as 85%, identify the Diameter of the jet ,Diameter of the wheel, Discharge and Number of jets .	BT-4	Analyzing
11.	An inward flow reaction turbine running at 500rpm has an external diameter 70cm and a width of 18cm. if the guide vanes are at 20^0 to the wheel tangent and absolute velocity of water at inlet is 25m/sec. Find discharge of the turbine(Q) and the runner vane angle at inlet (θ).	BT-4	Analyzing
12.	A Kaplan turbine develops 20,000Kw at a head of 35m and at a rotational speed of 420rpm. The outer diameter of the blades is 2.5m and the hub diameter is 0.85m. If the overall efficiency is 85% and the hydraulic efficiency is 88%, calculate the discharge, the inlet flow angle and the blade at the inlet.	BT-4	Analyzing
13.	An inward flow reaction turbine has outer and inner diameter has 1m and 0.5m respectively. The vanes are radial at inlet and the discharge is radial at outlet. The water enters the vane at an angle of 10^0.	BT-3	Applying

	Assuming the velocity of flow is constant and equal to 3m/sec. Find Speed of the wheel and Vane angle at Outlet.		
14.	Define Draft tube and write its function. Explain the various types of draft tubes.	BT-4	Analyzing
15.	A pelton wheel working under a head of 400m produces 12000kw at 400rpm. If the efficiency of the wheel (turbine) is 80%. Determine discharge of the turbine, diameter of the runner wheel and diameter of the nozzle. Assume suitable data.	BT-3	Applying
16.	An inward flow reaction turbine, having an external diameter of 2 m runs at 300 rpm. The velocity of flow at inlet is 12 m/s. If the guide blade angle is 15°, Find the absolute velocity of water, velocity of whirl at inlet, inlet vane angle and relative velocity at inlet.	BT-3	Applying
17.	A kaplan turbine runner is to be designed to develop 9000 kW. The net available head is 5.5 m. Assume a speed ratio 2, flow ratio 0.65 and total efficiency 85%. The diameter of the boss is 1/3 the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine.	BT-3	Applying
18	A Pelton wheel has a mean bucket speed of 10m/s with a jet of water flowing at rate of 700 litres/s under a head of 30m. The bucket deflects the jet through an angle (θ) 160^{0}. Calculate power given by water to the runner and the hydraulic efficiency of turbine. Assume C_v=0.98.	BT-4	Analyzing
19	A Kaplan turbine develops 0.9MW under a net head of 7.5m. Speed ratio (v/V) and flow ratio (V_f/V) is 2.2 and 0.66 respectively. The diameter of the boss or Hub is 0.35 times the diameter of the runner. The overall efficiency is 86%. Determine the runner diameter (D), diameter of boss (d), Speed and Specific Speed of turbine.	BT-3	Applying
20	A Straight Conical draft tube with inlet diameter 50cm and exit diameter 90cm is of 4m height. The tube is immersed to about 1m in water. The water enters the draft tube with a velocity of 5m/sec. Taking friction head loss is 20% of velocity head at entry. Find the pressure head at the entry, draft tube efficiency and power lost in friction.	BT-3	Applying
21	Explain the various efficiencies of hydraulic turbines.	BT-4	Analyzing
22	Write a brief note an classification of hydraulic turbine.	BT-3	Applying

UNIT – V: PUMPS

Classification of Pumps- Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitation's in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done- Gear pump.

PART - A

1.	What is meant by priming of pumps?	BT-1	Remembering
2.	What is net positive suction head in a centrifugal pump?	BT-1	Remembering
3.	Define specific speed of pump.	BT-1	Remembering
4.	What is meant by multistage pump?	BT-1	Remembering
5.	Define cavitation in pumps.	BT-1	Remembering
6.	Define suction and delivery strokes.	BT-1	Remembering

7.	Mention the main parts of centrifugal pump.	BT-2	Understanding
8.	List the types of impellers and casing for a centrifugal pump.	BT-2	Understanding
9.	What are the types of characteristic curves?	BT-2	Understanding
10.	Define slip of reciprocating pump.	BT-2	Understanding
11.	What is the role of a volute chamber of a centrifugal pump?	BT-1	Remembering
12.	Mention the main components of reciprocating pump.	BT-1	Remembering
13.	What is indicator diagram with sketch?	BT-1	Remembering
14.	Differentiate pump and turbine.	BT-2	Understanding
15.	What are the advantages of fitting air vessels in a Reciprocating Pump?	BT-2	Understanding
16.	Distinguish the positive displacement pump and roto dynamic pump?	BT-2	Understanding
17.	The difference between the water levels in the sump and the overhead tank is H. what is the total head to be generated by the pump for pumping the liquid?	BT-2	Understanding
18.	Write about negative slip. How does it occur?	BT-1	Remembering
19.	Write the equation for specific speed for pump and turbines.	BT-2	Understanding
20.	What is the function of foot valve in a pump?	BT-2	Understanding
21.	Define the term turbo-machines.	BT-1	Remembering
22.	Define the term specific speed of a centrifugal pump and deduce an expression for it in terms of the head H, discharge Q and the speed N.	BT-2	Understanding
23.	How will you classify the reciprocating pump?	BT-1	Remembering
24.	Define separation in a reciprocating pump and explain how it can be avoided.	BT-2	Understanding
25.	What are the factors which influence the speed of a reciprocating pump?	BT-1	Remembering

PART – B

1.	The outer diameter of an impeller of a Centrifugal pump is 400mm and outlet width 50mm. The pump is running at 800rpm and is working against a total head of 15m. The vane angle at outlet is 40^0 and manometric efficiency is 75%. Determine Velocity of flow at outlet(V_{f2}), Velocity of water leaving the vane(V_2),Angle made by absolute velocity at outlet in the direction of motion (angle which water leaves the impeller) and Discharge (Q).	BT-3	Applying
2.	A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40 degrees at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm. List the following Vane angle at inlet, Work done by impeller on water per second and Manometric efficiency.	BT-4	Analyzing
3.	A Centrifugal pump is to discharge $0.118m^3$/sec at speed of 1450rpm against a head of 25m. The impeller dia is 250mm. Its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of impeller.	BT-3	Applying

4.	A diameter of impeller of a Centrifugal pump at inlet and outlet are 30cm and 60cm respectively. The velocity of flow at outlet (V_{f2}) is 2m/s and vane is set back at an angle of 45^0 at the outlet. Determine minimum starting speed of pump if manometric efficiency is 70%.	BT-3	Applying
5.	For a centrifugal pump the suction lift is 2m, delivery height is 30m, head lost in the suction and delivery pipes due to friction are 0.8m and 3m respectively. The diameter of both suction and delivery pipe is 5cm.Find the power of the prime motar required, if Overall efficiency is 70%. Take manometric efficiency as 85%. Also determine the negative head at the suction side and positive head at the delivery side. Actual head developed is 40m. Take the atmospheric pressure head as 10.3m of water.	BT-3	Applying
6.	A Multistage Centrifugal pump is to be installed of lift water to head of 150m at the rate of 100litres/sec. The pump is coupled to an electric motor running at 1450rpm. Estimate the head developed per stage and no stage required, the required impeller diameter if the speed ratio based on impeller diameter is 0.9 and the power required if overall efficiency is 0.75.	BT-4	Analyzing
7.	Explain the working principle of Submersible pump with its advantages and disadvantages.	BT-4	Analyzing
8.	A single acting reciprocating pump running at 50 rpm delivers water at a rate of $0.01m^3$/sec. The diameter of the piston(D) is 200mm and stroke length L=400mm. Determine Theoritical discharge of the pump, Coefficient of discharge, slip and % slip of the pump and power required to drive the pump if h_s=25m and h_d=30m	BT-4	Analyzing
9.	Define Cavitation? What are the effects and precautions against cavitation?	BT-3	Applying
10.	The diameter and stroke of a single acting reciprocating pump are 200 mm and 400 mm respectively. The pump runs at 60rpm and lifts 12 litres of water per second through a height of 25m. The diameter and length of delivery pipe are 150 mm and 20 m respectively. Find out Theoretical discharge and theoretical power required to run the pump, Percentage slip and acceleration head at the beginning and middle of the delivery stroke.	BT-4	Analyzing
11.	The diameter and stroke length of a single acting reciprocating pump are 50mm and 100 mm respectively. It takes the supply of water from a sump 4 m below the pump through a pipe 6 m long and 30 mm in diameter. It delivers water to a tank 15 m above the pump through a pipe 40 mm in diameter and 20m long. If separation occurs 70 kN/m^2 below the atmospheric pressure, Report the maximum speed at which pump may be operated without separation. Assume that the piston has a simple harmonic motion.	BT-3	Applying
12.	A four stage centrifugal pump has 4 identical impeller keyed to the same shaft. The shaft is running at 400 rpm and the total manometric head developed by the multistage pump is 40m. The discharge through the pump is $0.2m^3$/sec. The vanes of each impeller are having outlet angle as 45^0. The width and diameter of impeller at outlet is 5cm and 60cm respectively. Find manometric efficiency.	BT-4	Analyzing
13.	A single acting reciprocating pump, running at 60rpm delivers $0.53m^3$ of water per minute. The diameter of the piston is 200mm	BT-3	Applying

	and stroke length 300mm. The suction and delivery heads are4m and 12m respectively. Determine the theoritical discharge, coefficient of discharge, percentage of slip of the pump and power required to run the pump.		
14.	Derive the expression for the minimum starting speed of a centrifugal pump if the outer diameter of the impeller is two times the inner diameter.	BT-4	Analyzing
15.	A centrifugal pump, having impeller diameter of 250 mm and 500 mm at inlet and outlet respectively is running at 800 rpm. The vanes are set back at an angle of 30° to the outer rim. If the velocity of flow through the impeller is constant at 2m/s, find vane angle at inlet and work done -per kg mass of water on the wheel.	BT-3	Applying
16.	A centrifugal pump is required to lift 0.013 cumec of water from a well depth 25 m. If the rating of the pump motor is 6 kW. Workout the efficiency of the pump.	BT-2	Understanding
17.	Discuss in general the main and operating characteristics of a centrifugal pump. What is the importance of constant efficiency curves?	BT-2	Understanding
18	Explain the working principle of centrifugal pump and its components with a neat sketch.	BT-4	Analyzing
19	A Centrifugal pump has the corresponding dimensions at the outlet are 700mm and 85mm respectively. The blades are curved backward at 30^0 to the tangent at exit. Assume radial entry. Calculate Theoritical head developed, Manometric efficiency, Pressure rise across the impeller, Pressure rise and loss of head in Volute Casing, Vane angle at inlet and delivers $0.4m^3/sec$ water to a height of 130m. The impeller rotates at 1100rpm and has a diameter 350mm and width 170mm at inlet, Power required to drive the pump assuming an overall efficiency of 75%.	BT-4	Analyzing
20	Show that the pressure rise in the impeller of a centrifugal pump is given by $(V_{f1}^2+u_2^2-V_{f2}^2\text{cosec}^2\phi)/2g$ provided the frictional and other losses in the impeller are neglected.	BT-3	Applying
21	Write and explain the working of Single acting and Double acting reciprocating pump with a neat sketch.	BT-3	Applying
22	A single acting reciprocating pump has the plunger diameter of 200 mm and stroke of 300 mm. The pump discharges water at the rate of $0.6m^3/m$ and at 65 rpm. Find the theoretical discharge, coefficient of discharge and percentage slip of the pump. If suction and delivery heads are 6 m and 18 m respectively, workout the power required to run the pump.	BT-3	Applying