VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

IV SEMESTER

CE 6403 - APPLIED HYDRAULIC ENGINEERING

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SUBJECT : 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 - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force - Critical depth and velocity.

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	Write the various types of flow in open channels?	BT-1	Remembering
5	Define hydraulic mean depth.	BT-1	Remembering
6	List the factors affecting Manning’s roughness coefficient.	BT-1	Remembering
7	Differentiate closed conduit flow and open channel flow.	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 between normal depth and alternate depth.	BT-2	Understanding
11	Sketch the velocity distribution in rectangular and triangular channels.	BT-3	Applying
12	Write about the most economical section?	BT-3	Applying
13	Write the Bazin’s formula for the discharge in the channel.	BT-3	Applying
14	Compare the prismatic channel with the non-prismatic channel.	BT-4	Analyzing
15	Find the relationship between Chezy's ‘C’ and Manning's ‘n’.	BT-4	Analyzing
16	Distinguish between steady uniform flow and unsteady non uniform flow.	BT-4	Analyzing
17	Compute the hydraulic mean depth of a small channel of 1m wide and 0.5m deep with water flowing at 2m/s.	BT-5	Evaluating
18	Select on what condition most economical trapezoidal channel section is derived?	BT-5	Evaluating
19	What is meant by specific force?	BT-6	Creating
20	Write about non-erodible channels. What are the factors considered while designing non-erodible channels?	BT-6	Creating

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-1	Remembering
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-1	Remembering
3.	A 3m wide rectangular channel conveys $12m^3$ of water at a depth of 2m. Find out 1. Specific energy of flowing fluid. (4) 2. Critical depth, critical velocity and the minimum specific energy. (4) 3. Froude number and state whether the flow is sub-critical or super critical. (5)	BT-1	Remembering
4.	(i)Find the discharge through a rectangular channel of width 2m, having a bed slope of 4 in 8000. The depth of flow is 1.5m. Use Chezy's formula, Take C=76. (6) (ii) Determine the most economical section of rectangular section carrying water at the rate of 0.6 cumecs. The bed slope of the channel is 1 in 2000. Assume Chezy's constant C=50. (7)	BT-1	Remembering
5.	(i) A rectangular channel which is laid on a bottom slope of 1 in 160 is to carry 20 m^3/s of water. Determine the width of the channel when the flow is in critical condition. Take Manning's constant n=0.014. (6) (ii) 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? (7)	BT-2	Understanding
6.	Derive the geometrical properties of a most economical triangular channel section.	BT-2	Understanding
7.	Derive chezy's formula for discharge through channel. Write the formula to find out the constant 'C'.	BT-2	Understanding
8.	Water flows at the rate of 20 cumecs in a rectangular channel 14m wide at a velocity of1.8 m/s. Determine the specific energy of the flowing water, critical velocity and minimum specific energy corresponding to this discharge, the Froude number and state whether the flow is subcritical or supercritical?	BT-3	Applying
9.	The bed width of a trapezoidal channel section is 40m and the side slope is 2 horizontal to 1 vertical. The discharge in the canal is 60 cumecs. The Manning's 'n' is 0.015 and the bed slope is 1 in 5000. Determine the normal depth.	BT-3	Applying
10.	A most economical trapezoidal section is required to give a maximum discharge if 20 m^3/s of water. The slope of the channel bottom is 1 in 1500. Taking C=70 in Chezy's equation, determine the dimensions of the channel.	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	BT-4	Analyzing

	meter length of the channel.		
12.	For a trapezoidal channel with bottom width 40 m and side slopes 2H:1V, Manning's N is 0.015 and bottom slope is 0.0002. If it carries 60m^3/s discharge, determine the normal depth.	BT-4	Analyzing
13.	Appraise the slope of the channel. A V-shaped open channel of included angle 90^o conveys a discharge of 0.05m^3/s when the depth of flow at the centre is 0.225m. Assume that C=50 in chezy's equation.	BT-5	Evaluating
14.	Determine the critical depth for a specific energy of 1.5m in the following channels: 1. Rectangular channel (4) 2. Triangular channel (4) 3. Trapezoidal channel (5)	BT-6	Creating

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-3	Applying
2.	(i) A trapezoidal channel has a bottom width of 6.1m and side slopes of 2H:1V. When the depth of flow is 1.7m, the flow is 10.47m^3/s. What is the specific energy of flow? Is the flow tranquil or rapid? (7) (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-2	Understanding
3.	Derive the expressions for the most economical depths of flow terms of the diameter of the channel of circular cross-section: (i) For maximum velocity and (7) (ii) For maximum discharge. (8)	BT-4	Analyzing
4.	(i) The specific energy for a 3 m wide channel is 8 Nm/N. What is the maximum possible discharge in the channel? (7) (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

UNIT – II: GRADUALLY VARIED FLOW

Dynamic equations of gradually varied and spatially varied flows - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method, Graphical method - Applications.

PART – A

1.	Define varied flow. Explain its classification.	BT-1	Remembering
2.	List the assumption made in the derivation of dynamic equation for gradually varied flow.	BT-1	Remembering
3.	List the classification of spatially varied flow based on discharge?	BT-1	Remembering
4.	Classify the channel bottom slopes.	BT-4	Analyzing

5.	Define spatially varied flow.	BT-1	Remembering
6.	What is the nature of slope of the channel if critical depth line occurs above normal depth line?	BT-2	Understanding
7.	Distinguish between gradually varied flow and rapidly varied flow in open channel.	BT-2	Analyzing
8.	Sketch the different zones of water surface profiles in critical and mild sloped channels.	BT-1	Remembering
9.	Classify the surface profiles in channels.	BT-2	Understanding
10.	Write down the condition for mild slope and critical slope?	BT-6	Creating
11.	Illustrate the methods used to determine the length of surface profile.	BT-3	Applying
12.	Write the expression to determine the length of the backwater curve.	BT-3	Applying
13.	Distinguish between draw down and back water curve.	BT-4	Analyzing
14.	What is meant by standard step method?	BT-4	Analyzing
15.	Write about drawdown curves.	BT-3	Applying
16.	Differentiate afflux and backwater curve.	BT-2	Understanding
17.	Give the formulas related to Direct Step Method.	BT-5	Evaluating
18.	If the depth increases in the direction of flow what type of curve is formed?	BT-5	Evaluating
19.	What are the three methods to calculate Surface profiles in prismatic channel?	BT-1	Remembering
20.	What is backwater curve in gradually varied flow profile and give practical example for getting this type of profile.	BT-6	Creating

PART –B

1.	Find the slope of the free water surface in a rectangular channel of width20m, having depth of flow 5m. The discharge through the channel is 52cumecs. The bed slope of the channel is 1 in 4000. Assume Chezy's constant C as 60.	BT-1	Remembering
2.	Derive the dynamic equation of the GVF.	BT-1	Remembering
3.	A rectangular channel 10 m wide carries a discharge of 30 m^3/s. It is laid at a slope of 0.00001. If at a section in this channel the depth is 1.6 m, how far (upstream or downstream) from the section will the depth be 2.0 m? Take Manning's n as 0.015.	BT-1	Remembering
4.	Classify the different surface profiles for the various bottom slope condition of a channels.	BT-2	Understanding
5.	At a certain section M in a rectangular channel of bed width 2m, the depth of flow 1.20m. When the flow rate is 6.0m^3/s, estimate the distance from M to another section N where the depth is 1.40m. The bed slope is 0.002 and Manning's 'n'=0.015. Take two steps.	BT-2	Understanding
6.	The bed width of a rectangular channel is 24m and depth of flow is 6m. The discharge in the channel is 86 cumecs. The bed slope of the channel is 1 in 4000. Assume chezy's constant C=60. Calculate the slope of the free water surface.	BT-3	Applying
7.	A rectangular flume is 1.5m wide carries discharge at the rate of 2m^3/s. The bed slope of the flume is 0.0004. At a certain section, the depth of flow is 1m. Calculate the	BT-1	Remembering

	(i) Distance of the section downstream where the depth of flow is 0.75m. Solve by single slope method. Assuming rugosity coefficient as 0.014. (10) (ii) Is the slope of the channel mild or steep? (3)		
8.	(i) Explain the various types of channel slopes with neat sketch. (7) (ii) Write down the various curves formed in each slope. (6)	BT-4	Analyzing
9.	Briefly explain the direct step method and standard step method to determine the gradually varied flow profiles.	BT-3	Applying
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.	A river 90m wide and 3m deep has a stable bed banks with a surface slope 1 in 2500.Estimate the length of back water curve produced by an afflux of 2m. Assume Manning's N=0.035.	BT-2	Understanding
12.	Explain the step method of integrating the varied flow equation for the channel section.	BT-4	Analyzing
13.	A trapezoidal channel of bed width 10 m and side slopes 1 V :1.5 H is carrying a flow of 80 m^3/s. The channel bottom slope is 0.002 and Manning's 'n' is 0.015. A dam is planned in such a way that the depth Of flow increases to 10 m. Evaluate the depth of flow in the channel 250 m, 500 m and 750m upstream of the dam. Use the standard step method.	BT-5	Evaluating
14.	Write an expression for the length of Backwater Curve.	BT-6	Creating

PART-C

1.	Summarize the assumptions made in the derivation of the dynamic equation for gradually varied flow. Starting from the first principles, derive equations for the slope of the water surface in gradually varied flow with respect to i. Channel bed (7) ii. Horizontal. (6)	BT-2	Understanding
2.	The bed width of a trapezoidal channel section is 40 m and the side slope is 2 horizontal to 1 vertical. The discharge in the canal is 60 cumecs. The Manning's 'n' is 0.015 and the bed slope is 1 in 5000. Examine the normal depth.	BT-3	Applying
3.	A river 100m wide and 3m deep has an average bed slope of 0.0005. Find the length of the GVF profile produced by a low weir which raises the water surface juts upstream of it by 1.5m. Assume Manning's N=0.035. Use direct step method with 3 steps.	BT-1	Remembering
4.	Show the profile determination by numerical method for calculating the length of water surface profile.	BT-4	Analyzing

UNIT – III: RAPIDLY VARIED FLOW

Application of the energy equation for RVF - Critical depth and velocity - Critical, Sub-critical and Super-critical flow - Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation - Surges and surge through channel transitions.

PART - A

1.	Define critical flow.	BT-1	Remembering
2.	Define critical velocity	BT-1	Remembering
3.	State the condition for critical and super critical flow	BT-1	Remembering
4.	Define the terms: hydraulic gradient line and total energy line.	BT-1	Remembering
5.	Write the head loss equation for Hydraulic jump	BT-1	Remembering
6.	What is mean by energy dissipation?	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.	Explain the energy loss in a hydraulic jump?	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-3	Applying
12.	Describe the uses of hydraulic jump.	BT-3	Applying
13.	What is the condition for getting hydraulic jump in open channel?	BT-3	Applying
14.	Write down the types of surges.	BT-4	Analyzing
15.	Differentiate the positive and negative surges?	BT-4	Analyzing
16.	Justify the transition in open channel?	BT-5	Evaluating
17.	Write down the application of transition	BT-5	Evaluating
18.	What is the state of flow after formation of a hydraulic jump?	BT-6	Creating
19.	Write about surges?	BT-6	Creating
20.	Write the ranges of Froude number before and after the hydraulic jump	BT-4	Analyzing

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 (1) The specific energy (2) The critical depth (3) The subsequent depths (4) Loss of head (5) Energy dissipated.	BT-2	Understanding
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-2	Understanding
3.	A spillway discharges a flood flow at a rate of 7.75 m^3/s per metre 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-4	Analyzing
4.	The depth of flow of water at a certain section of rectangular channel 2m wide is 0.25m. The discharge through the channel is $1.8m^3/s$. Whether a hydraulic jump will occur and if so, determine its height	BT-4	Analyzing

	and loss of energy per kg of water.		
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 0.2 m to 0.5 m. List the discharge in the channel and the loss of head due to the formation of hydraulic jump.	BT-1	Remembering
7.	A rectangular channel carries a flow with a velocity of 0.65 m/s and depth of 1.4m. If the discharge is abruptly increased three fold by sudden lifting of a gate on the upstream. Estimate the velocity and height of the resulting surge?	BT-1	Remembering
8.	i. Explain the classification of hydraulic jumps. (7) ii. Write the expression for depth of hydraulic jump. (6)	BT-2	Understanding
9.	Discuss the types of surges briefly.	BT-1	Remembering
10.	Define hydraulic jump. How the energy dissipated? Explain in detail.	BT-1	Remembering
11.	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4m. The width of the channel is 8m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	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.	A sluice gate discharges $2.5m^3/s$ into a wide horizontal rectangular channel. The depth at the vena-contracta is 0.2m. The tail water depth is 2.0m. Assuming the channel to have a Manning's n=0.015, determine the location of the hydraulic jump. Consider the bed slope as 0.0005.	BT-5	Evaluating
14.	A trapezoidal channel is 2.0 m wide at the bottom and has side slope of 1.5 horizontal: 1 vertical. Construct the specific-force diagram for a discharge 13.5 m^3/s in this channel. For this discharge find the depth sequent to the supercritical depth of 0.5 m.	BT-6	Creating

PART-C

1.	Derive an expression for the loss of head in hydraulic jump.	BT-3	Applying
2.	A venture flume is 1.30m wide at entrance and 0.65m in the throat. Neglecting the 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 200mm, so that a standing wave (Hydraulic jump) is formed beyond the throat. What is the increase in the upstream depth when the same flow as before passes through the flume?	BT-4	Analyzing
3.	A sluice gate at the base of a large reservoir is raised 1.7 m, as shown opposite, and the water discharges through this 5.0 m-wide rectangular orifice into a rectangular channel of the same width. If a hydraulic jump forms in the channel, what will be its height?	BT-3	Applying
4.	The depth and velocity of flow in a rectangular channel are 1m and	BT-2	Understanding

	1.5m/s respectively. If the rate of inflow at the upstream end is suddenly doubled, what will be the height and absolute velocity of the resulting surge and celerity of the wave?		

UNIT – IV: TURBINES

Impact of Jet on vanes - Turbines - Classification - Reaction turbines - Francis turbine, Radial flow turbines, draft tube and cavitation - Propeller and Kaplan turbines - Impulse turbine - Performance of turbine - Specific speed - Runaway speed - Similarity laws.

PART – A

1	What is hydraulic turbine?	BT-1	Remembering
2	State radial flow turbine.	BT-1	Remembering
3	Define hydraulic efficiency	BT-1	Remembering
4	What is overall efficiency in turbines?	BT-1	Remembering
5	Define specific speed of a turbine.	BT-1	Remembering
6	Define cavitation	BT-1	Remembering
7	Classify hydraulic turbines?	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-3	Applying
12	Draw typical velocity triangles for inlet and outlet of pelton wheel.	BT-3	Applying
13	What are the uses of draft tubes	BT-3	Applying
14	Differentiate the impulse and reaction turbine.	BT-4	Analyzing
15	What are the types of turbine according to direction of flow through runner?	BT-4	Analyzing
16	Differentiate the inward flow reaction turbine and outward flow reaction turbine.	BT-4	Analyzing
17	Why draft tubes not used in impulse turbines?	BT-5	Evaluating
18	Write the function of draft tube in turbine outlet.	BT-5	Evaluating
19	What is the purpose of providing casing in turbine?	BT-6	Creating
20	Write about governing of turbines?	BT-6	Creating

PART B

1	A Pelton wheel operates with a jet of 200 mm diameter under the head of 600 m, its mean runner diameter is 2.50 m and it runs with a speed of 400 rpm. The outlet bucket tip angle is 15º, coefficient of velocity is 0.99, mechanical losses equal to 4% of power supplied and the reduction in relative velocity of water while passing through bucket is 20%. Find the following i. Force of jet on the bucket (3)	BT-1	Remembering

	ii. Power developed (4) iii. Bucket efficiency (3) iv. Overall efficiency. (3)		
2	A Pelton turbine is required to develop 9000 kW when working under a head of 300 m. The runner may rotate at 500 rpm. Assuming the jet ratio as 10, speed ratio as 0.46 and overall efficiency as 85%, Find the following: i. Quantity of water required (3) ii. Diameter of the wheel (3) iii. Number of jets (3) iv. Number of buckets. (4)	BT-1	Remembering
3	A jet of water having a velocity of 40 m/s strikes a curves vane which is moving with a velocity of 20 m/s. The jet makes an angle of 30˚ with the direction of motion of vane at inlet and leaves at an angle of 90˚ to the direction of motion of vane at outlet. (i) Draw the velocity triangles at inlet and outlet (6) (ii)Identify the vane angles at inlet and outlet so that the water enters and leaves the vane without shock. (7)	BT-1	Remembering
4	A Pelton wheel is to be designed for the following specification: i. Power (brake or shaft) = 9560kW ii. Head = 350 meters iii. Speed = 750 rpm iv. Overall efficiency = 85% v. Jet diameter = not to exceed 1/16th of the wheel diameter Find out the following : i. Wheel diameter (4) ii. Diameter of the jet (5) iii. Number of jets required (4) Take C=0.985 and speed ration=0.45	BT-1	Remembering
5	A Pelton wheel is required to develop 8825 kW when working under the head of 300m. The speed of the Pelton wheel is 540 rpm. The coefficient of velocity for the jet is 0.987, speed ratio is 0.46. Assuming the jet ratio as 10 and overall efficiency as 84%.Estimate the i. Number of jets (3) ii. Diameter of the wheel (5) iii. Quantity of water required (5)	BT-2	Understanding
6	(i)Classify the turbines based on : 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. (6)	BT-2	Understanding
7	(i) Explain in detail about the main parts of Pelton wheel turbine (8) (ii) Draw the characteristics curves of turbines and explain it. (5)	BT-2	Understanding
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˚.	BT-3	Applying

	(i)Calculate the weight of the plate. (6) (ii)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? (7)		
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 Calculate (i)Velocity of flow to be constant (4) (ii) Vane angle at inlet (5) (iii) Head of water on the wheel (4)	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 (i) Diameter of the jet (3) (ii) Diameter of the wheel (3) (iii) Discharge (4) (iv) Number of jets (3)	BT-4	Analyzing
11	An inward flow reaction turbine operates under a head of 25m running at 200 rpm. The peripheral velocity of the runner is 2m/s and the radial velocity at the runner exit is 15m/s. If the hydraulic losses are 20% of the available head, Identify the following (i) Guide vane angle (2) (ii) Runner vane angle (3) (iii) Runner diameter (2) (iv) Specific speed, if the width of the runner at the periphery is 30cm (3) (v) Power produced by the turbine (3)	BT-4	Analyzing
12	A Francis turbine is to be designed to develop 360 kW under a head of 70 m and a speed of 750 rpm. The ratio of width of runner to diameter of runner 'n' is 0.1. The inner diameter of the runner is half the outer diameter. The flow ratio is 0.15. The hydraulic efficiency is 95% and the mechanical efficiency is 84%. Four percent of the circumferential area of runner is to be occupied by the thickness of the vanes. The velocity of flow is constant and the discharge is radial at exit. Examine the following: i. The diameter of the wheel (3) ii. The quantity of water supplied (3) iii. The guide vane angle at inlet and (4) iv. Runner vane angles at inlet and exit (3)	BT-4	Analyzing
13	An impulse wheel has a mean bucket speed of 10m/s with a jet of water flowing at the rate of 1m^3/s under a head of 50m. The buckets deflect the jet through an angle of 165˚. Evaluate the (i)Power given by water to the runner (6) (ii)Hydraulic efficiency of the turbine. (7) Assume the coefficient of velocity as 0.99.	BT-5	Evaluating
14	(i)Define Draft tube and write its function. (6) (ii)Explain the various types of draft tubes. (7)	BT-6	Creating

PART – C

1	A Pelton wheel is to designed for the following specification: Shaft power = 11,772 kW, Head = 380 m, Speed = 750 rpm, Overall efficiency = 80%, Jet diameter is not to exceed 1/16 of the wheel diameter. Find out the following: (i) Wheel diameter (5) (ii) Number of jets required (5) (iii) Diameter of jet (5) Assume K_v=0.985 and K_u =0.45.	BT-1	Remembering
2	i. Draw the characteristics curve of turbines and explain. (7) ii. Explain the various efficiencies of hydraulic turbines. (8)	BT-2	Understanding
3	i. Show the expression for impulse momentum principle. (8) ii. What are the various application of momentum principle explain? (7)	BT-3	Applying
4	A Kaplan turbine is to be designed to develop 9100kW. The net available head is 5.6m. The speed ratio is 2.09 and the flow ratio is 0.68. The overall efficiency is 86% and the diameter of the boss is one-third the diameter of the runner. Examine i. Diameter of the runner (5) ii. Speed (5) iii. Specific speed of the turbine (5)	BT-4	Analyzing

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UNIT – V: PUMPS

Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitations in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Flow separation conditions - Air vessels, indicator diagrams and its variations - Savings in work done - Rotary pumps: 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	Classify pumps on the basis of transfer of mechanical energy.	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	Give detail about an air vessel? State its function	BT-2	Understanding
11	What is the role of a volute chamber of a centrifugal pump?	BT-3	Applying
12	Mention the main components of reciprocating pump.	BT-3	Applying
13	What is indicator diagram with sketch?	BT-3	Applying
14	Differentiate pump and turbine.	BT-4	Analyzing
15	Criticize the manometric efficiency and mechanical efficiency of a centrifugal pump?	BT-4	Analyzing
16	Distinguish the positive displacement pump and roto dynamic pump?	BT-4	Analyzing
17	The difference between the water levels in the sump and the overhead	BT-5	Evaluating

	tank is H. what is the total head to be generated by the pump for pumping the liquid?		
18	Write about negative slip. How does it occur?	BT-5	Evaluating
19	Write the equation for specific speed for pump and turbines.	BT-6	Creating
20	What is the function of foot valve in a pump?	BT-6	Creating

PART-B

1	List the following (1) total head, (2) capacity and (3) overall efficiency of a single acting three throw pump with diameter of each cylinder = 28cm, stroke = 42 cm, speed = 120 rpm, suction head =2.5 m suction pipe diameter = 20 cm, suction pipe length = 5 m, delivery head = 12m, delivery pipe diameter = 15 cm, length of delivery pipe = 18 m, coefficient of friction =0.008, and shaft power = 65 kW. Air vessel is provided with both suction and delivery pipes.	BT-1	Remembering
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 i. Vane angle at inlet (4) ii. Work done by impeller on water per second (4) iii. Manometric efficiency (5)	BT-1	Remembering
3	i. Describe the working principle of double acting reciprocating pump with a neat sketch. (6) ii. A single acting reciprocating has a plunger diameter of 250mm and stroke length of 350 mm. The speed of the pump is 60 rpm and the discharge is 0.02 cumecs of water. List the following: 1. The theoretical discharge (2) 2. Coefficient of discharge (2) 3. Percentage slip (3)	BT-1	Remembering
4	The centrifugal pump has the following characteristics. Outer diameter of impeller is 800mm: width of the impeller vane at outlet = 100mm: angle of the impeller vanes at outlet is 40degree. The impeller runs at 550 rpm and delivers 0.89m3/sec under an effective head of 35m. A 500kW motor is used to drive the pump. Identify the manometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet.	BT-1	Remembering
5	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-2	Understanding
6.	i. Discuss the construction details and working principles of a centrifugal pump. (8) ii. A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at	BT-2	Understanding

	outlet is 50 mm and manometric efficiency is 75%. Estimate the vane length at the outer periphery of the impeller. (5)		
7	Estimate the vane angle at the inlet of a centrifugal pump impeller having 200mm diameter at the inlet and 400mm diameter at outlet. The impeller vanes are set back at angle of 45 degree to the outer rim and the entry of the pump is radial. The pump runs at 1,000rpm and the velocity of flow through the impeller is constant at 3m/s. also calculate the work done per kN of water and the velocity as well as direction of the water at outlet.	BT-2	Understanding
8	Illustrate the indicator diagram of a reciprocating pump with a neat sketch i. Without air vessels on both suction and delivery sides. (6) ii. With air vessels only on suction side. (7)	BT-3	Applying
9	The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 rpm, are 200 mm and 400 mm respectively. The discharge through pump is $0.04m^3/s$ and velocity of flow is constant and equal to 2 m/s. The diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6 m and 30 m of water respectively. If the outlet vane angle is 45^0 and power required to drive the pump is 16.186 kW, Determine i. Vane angle of the impeller at inlet, (4) ii. Overall efficiency of the pump, (4) iii. Manometric efficiency of the pump (5)	BT-3	Applying
10	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-4	Analyzing
11	The impeller of a centrifugal pump has an external diameter of 450 mm and internal diameter of 200 mm. The speed of the pump is 1440 rpm. Assuming a constant radial flow through the impeller at 2.5 m/s and that the vanes at exit are set back at an angle of 25^0, determine i. The inlet vane angle (4) ii. The angle, the absolute velocity of water at exit makes with the tangent and (4) iii. The work done per unit weight (5)	BT-4	Analyzing
12	A double acting reciprocating pump, running at 40 rpm, is discharging 1 m^3/s water. The pump has a stroke length of 400 mm. The diameter of the piston is 200 mm. the delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump.	BT-4	Analyzing
13	The diameter and stroke of a single acting reciprocating pump are 120 mm and 300 mm respectively. The water is lifted by a pump through a total head of 25m. The diameter and length of delivery pipe are 100 mm and 20 m respectively. Find out i. Theoretical discharge and theoretical power required to run the pump if its speed is 60 rpm, (6) ii. Percentage slip, if the actual discharge is 2.951m/s. (7)	BT-5	Evaluating
14	The cylinder of a single acting reciprocating pump is 15 cm in diameter and 30 cm in stroke. The pump is running at 30 rpm and discharge water to a height of 12 m. The diameter and length of the delivery pipe are 10 cm and 30 cm respectively. If a large air vessel is fitted in the delivery	BT-6	Creating

	pipe at a distance of 2m from the centre of the pump, find the pressure head in the cylinder. i. At the beginning of delivery stroke, ii. In the middle of the delivery stroke. Take f = 0.01.		

PART – C

1.	Explain the working principle of multi stage centrifugal pump with a neat sketch.	BT-1	Remembering
2.	Derive an expression for the power saved by fitting an air vessel to a single acting reciprocating pump.	BT-1	Remembering
3.	Show that the pressure rise in the impeller of a centrifugal pump is given by $(V_f^2+u_1^2-V_{f1}^2 \mathrm{cosec}^2\phi)/2g$ provided the frictional and other losses in the impeller are neglected.	BT-2	Understanding
4.	Write and explain the working of rotary pump, gear pump and draw the performance curve	BT-2	Understanding

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CE6403: APPLIED HYDRAULIC ENGINEERING

QUESTION BANK

S.no	UNIT NO.		BT1	BT2	BT3	BT4	BT5	BT6	Total Question
1	**Unit-1**	Part-A	6	4	3	3	2	2	20
		Part-B	3	2	2	1	1	1	10
		Part-C	-	1	2	1	-	-	4
2	**Unit-2**	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	1	1	1	-	-	4
3	**Unit-3**	Part-A	6	4	3	3	2	2	20
		Part-B	3	2	2	1	1	1	10
		Part-C	-	1	2	1	-	-	4
4	**Unit-4**	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	1	1	1	-	-	4
5	**Unit-5**	Part-A	6	4	3	3	2	2	20
		Part-B	3	2	1	2	1	1	10
		Part-C	2	2	-	-	-		4

TOTAL NO. OF QUESTIONS IN EACH PART

PART-A	100
PART-B	70
PART-C	20
TOTAL	190