Roll No. | | | | | | | | | | |



**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

**B.E. (Full Time) - END SEMESTER EXAMINATIONS, Nov/Dec 2024**

B.E. CIVIL ENGINEERING IV Semester

**CE 7401 APPLIED HYDRAULIC ENGINEERING**

(Regulation 2015)

Time: 3hrs Max.Marks: 100

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|---|---|
| CO 1 | Describe the basics of open channel flows, its classifications and analysis of uniform flow in steady state conditions with specific energy concept and its application. |
| CO 2 | Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades. |
| CO 3 | Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges |
| CO 4 | Design turbines and explain the working principle |
| CO 5 | Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps. |

**BL – Bloom's Taxonomy Levels**
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

## PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1 | Differentiate pipe flow and open channel flow. | 2 | 1 | 1 |
| 2 | Where will be the maximum velocity will occur in open channel flows-Why it happens? | 2 | 1 | 2 |
| 3 | Draw the water surface profile for a change of slope from steep to steeper. | 2 | 2 | 2 |
| 4 | What are advantage of standard step method in calculating water surface profile length. | 2 | 2 | 2 |
| 5 | Describe the characteristics of steady jump. | 2 | 3 | 1 |
| 6 | What is type-1 surge? Give an example. | 2 | 3 | 2 |
| 7 | How turbines are classified based on energy available at inlet? | 2 | 4 | 2 |
| 8 | The modern Francis turbine is a mixed flow turbine-Justify. | 2 | 4 | 2 |
| 9 | Why priming is necessary for a centrifugal pump? | 2 | 5 | 2 |
| 10 | What is air vessel and its functions in reciprocating pump? | 2 | 5 | 2 |

## PART- B (5 x 13 = 65 Marks)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 11 (a) | A trapezoidal channel has side slopes of 1H:1V and is required to carry 14 $m^3/s$ with a bed slope of 1 in 1000. If unlined the value of Chezy's C = 45. If lined with concrete its value is 65. If the cost of excavation per $m^3$ is nine times the cost per $m^2$ of lining, determine whether the lined or unlined channel would be cheaper? The section can be assumed to be hydraulically efficient. | 13 | 1 | 4 |
| | OR | | | |
| 11 (b) | A sewer pipe is to be laid at a slope of 1 in 8000 to carry a maximum discharge of 600 L/s when the depth of water is 75% of the vertical | 13 | 1 | 4 |

| | | | | |
|---|---|---|---|---|
| | diameter. Find the diameter of this pipe if the value of Manning's n = 0.025 | | | |
| 12 (a) | Establish the relationship among normal depth ($y_n$ or $y_o$), critical depth ($y_c$) and given depth (y) in GVF using Chezy's or Manning's equation for a wide rectangular channel and briefly explain the characteristics of $M_3$, $S_2$, and $C_3$ profiles. | **13** | 2 | 3 |
| | **OR** | | | |
| 12 (b) | A wide rectangular channel carries a discharge intensity of 4 $m^3/s/m$. The longitudinal slope of the channel is 0.0005. Identify the GVF profile produced by a sudden drop in the bed of the channel. Calculate the length of the profile up to $0.6y_n$. Assume Manning's n = 0.025. | **13** | 2 | 3 |
| 13 (a) | A hydraulic jump is occurring in a horizontal rectangular channel. If the jump is expected to dissipate 5 m head of water in the formation of the jump, and if inlet Froude number is 7, find the sequent depths and discharge per unit width of the channel. For the same initial depth, if the energy loss has to be increased by 25%, find the post jump depth and length of the jump. | **13** | 3 | 4 |
| | **OR** | | | |
| 13 (b) | A 2m wide rectangular channel, 2 km long carries a steady flow of 4.6 $m^3/s$ at a depth of 1.15 m. The sides of the channel are 2m high. If the flow is suddenly stopped by the closure of a gate at the downstream end, will the water spill over the sides of the channel? If there is no spillage, what minimum time interval must elapse before the arrival of the surge at the upstream end? | **13** | 3 | 4 |
| 14 (a) | The penstock supplies water from a reservoir to the Pelton wheel with a gross head of 500 m. One-third of the gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of penstock is 2 $m^3/s$. The angle of deflection of the jet is 165°. Determine the power given by the water to the runner and also hydraulic efficiency of the Pelton wheel. Assume speed ratio = 0.45 and Co-efficient of velocity = 1. | **13** | 4 | 4 |
| | **OR** | | | |
| 14 (b) | A Kaplan turbine working under a head of 25 m develops 16000 kW shaft power. The outer diameter of the runner is 4m and hub diameter is 2 m. The guide blade angle is 35°. The hydraulic and overall efficiencies are 90% and 85% respectively. If the velocity of whirl is zero at outlet, determine runner vane angles at inlet and outlet, and speed of the turbine. | **13** | 4 | 4 |
| 15 (a) | A centrifugal pump impeller has an outer diameter of 30 cm and an inner diameter of 15 cm. The pump runs at 1200 rpm. The impeller vanes are set at a blade angle of 30° at the outlet. If the velocity of flow is constant at 2 m/s, calculate (1) the absolute velocity and direction of water at outlet (2) the head developed, by assuming a manometric efficiency of 0.85 and (3) the blade angle at the inlet. | **13** | 5 | 3 |
| | **OR** | | | |
| 15 (b) | Derive an expression for the work done per second in case of single acting reciprocating pump with an indicator diagram considering, the effect of acceleration and friction in suction and delivery pipes. | **13** | 5 | 3 |

## PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 16. | In a rectangular channel 3 m wide, water flows with a velocity of 1 m/s with depth of 2 m. At a certain section the width is reduced to 1.8 m and the bed is raised by 0.675 m. Will the upstream depth be affected? If so, to what extend? Draw the plan and elevation of the cross section. | **15** | 1 | 6 |