



B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Fourth Semester

CIVIL ENGINEERING

U18CEI4201: Applied Hydraulics and Hydraulic Machinery

COURSE OUTCOMES

CO1: Design most economical section for an open channel

CO2: Analyse critical flow condition in channels.

CO3: Determine GVF profiles

CO4: Select appropriate type of turbines for the given conditions.

CO5: Assess the characteristics of pumps and turbines.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions: -

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

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| 1. Define open channel flow with example. | CO1 | [K ₂] |
| 2. What is meant by hydraulic depth? | CO1 | [K ₂] |
| 3. Define critical flow. | CO2 | [K ₂] |
| 4. What is specific energy and what is condition for obtaining only one depth for a given specific energy? | CO2 | [K ₂] |
| 5. What are the assumptions of gradually varying flow profile? | CO3 | [K ₂] |
| 6. What is meant by Hydraulic jump | CO3 | [K ₂] |
| 7. Differentiate impulse turbine and reaction turbine. | CO4 | [K ₂] |
| 8. List the types of turbines according to direction of flow through runner | CO4 | [K ₂] |
| 9. Define cavitation in pumps? | CO5 | [K ₂] |
| 10. What are the advantages of fitting air vessels in a Reciprocating Pump? | CO5 | [K ₂] |

Answer any FIVE Questions: -

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

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|---|---|-----|-------------------|
| 11. a) An open channel of the most-economical section, having the form of a half hexagon with horizontal bottom is required to give a maximum discharge if 20.3 cumecs of water. The slope of the channel bottom is 1 in 2500. Take Chezy's | 8 | CO1 | [K ₃] |
|---|---|-----|-------------------|

constant, $C = 60$ in Chezy's equation, determine the dimensions of the cross-section.

- b) The discharge in a channel with bottom width 3 m is $12 \text{ m}^3/\text{s}$. If Manning's n is 0.013 and the streamwise slope is 1 in 200, find the normal depth if:
- (a) the channel has vertical sides (i.e. rectangular channel) and
 - (b) the channel is trapezoidal with side slopes 2H:1V
12. a) The specific energy for a 6m wide rectangular channel is to be 5 kg-m/k. If the rate of flow of water through the channel is $24 \text{ m}^3/\text{s}$, determine the alternate depth of flow.
- b) The discharge of water through a rectangular channel of width 6m, is $18 \text{ m}^3/\text{s}$ when depth of flow of water is 2m. Calculate
- i) specific energy of the flowing water
 - ii) critical depth and critical velocity and
 - iii) value of the minimum energy.
13. a) A discharge of 1000 lt/s flows along a rectangular channel, 1.5 m wide. What would be the critical depth in the channel? If a standing wave is to be formed at a point where the upstream depth is 180mm, what would be the rise in the water level?
- b) Classify Water Surface profile based on the bed slopes and sketch the region of occurrence of flow profiles.
14. a) A pelton wheel is to be designed for the following specifications. Power = 735.75kW Shaft power, Head = 200m, Speed = 800 r.p.m, overall efficiency = 0.86 and jet diameter is not to exceed one tenth the wheel diameter. Take $C_v = 0.98$ and speed ratio = 0.45.
- Determine:
- i) Wheel diameter,
 - ii) Number of jets required and
 - iii) Diameter of the jet.

- b) The following data is given for a Francis turbine: net head = 70m, speed = 600 r.p.m, shaft power = 367.875kW, overall efficiency = 85% hydraulic efficiency = 95%, flow ratio = 0.25, breadth ratio = 0.1, outer diameter of the runner = 2 x inner diameter of runner. The thickness of vane occupies 10% of the circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. 8 CO4 [K₃]
- Determine:
- Guide blade angle,
 - Runner vane angle at inlet and outlet,
 - Diameter of runner at inlet and outlet
 - Width of wheel at inlet.
15. a) A reaction turbine works at 450rpm under a head of 120m. Its diameter at inlet is 120cm and flow area is 0.4m². The angles made by absolute and relative velocities at inlet are 200 and 600 respectively, with the tangential velocity. Determine i) Volume flow rate ii) the power developed iii) The hydraulic efficiency η_h . Assume whirl at outlet is zero. 8 CO5 [K₃]
- b) A single acting reciprocating pump running at 50 r.p.m. delivers 0.01 m³/s of water. The diameter of piston is 200mm and stroke length in 400mm. Determine i) The theoretical discharge of pump ii) Co-efficient of discharge iii) Slip and the percentage slip of pump. 8 CO5 [K₃]
16. a) A single acting reciprocating pump has a cylinder of diameter 150mm and stroke length 300mm. The center of the pump is 4m above the water surface in the sump. The atmospheric pressure head is 10.3m of water and the pump is running at 40 r.p.m. If the length and diameter of the suction pipe are 5m and 10cm respectively. Determine the pressure head due to acceleration in the cylinder 8 CO5 [K₃]
- At the beginning of the suction stroke and
In the middle of the suction stroke.
- b) Describe briefly on the classification of Hydraulic Turbines: 8 CO5 [K₂]
