# University of Mumbai

Program: **TE (CIVIL)**

Curriculum Scheme: Rev2019

Examination: TE Semester V

Course Code: CEC502 and Course Name: Applied Hydraulics

Time: 2 hour 30 minutes Max. Marks: 80

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| **Q1.** | **Choose the correct option for following questions. All the Questions are compulsory and carry equal marks** |
|---|---|
| 1. | The fluid coming into the centrifugal pump is accelerated by _____ |
| Option A: | Throttle |
| Option B: | Impeller |
| Option C: | Nozzle |
| Option D: | Governor |
| | |
| 2. | Two Pelton wheels A and B have the same specific speed and are working under the same head. Wheel A produces 400 kW at 1000 rpm. If B produces 100 kW, then its rpm is |
| Option A: | 4000 |
| Option B: | 2000 |
| Option C: | 1500 |
| Option D: | 1250 |
| | |
| 3. | Calculate the mean hydraulic radius for a channel having 20m2 cross sectional area and 50m of wetted perimeter |
| Option A: | 0.4 m |
| Option B: | 0.5 m |
| Option C: | 0.6 m |
| Option D: | 0.3 m |
| | |
| 4. | Impulse Momentum equation is based on |
| Option A: | Newton's First law of motion |
| Option B: | Newton's Second law of motion |
| Option C: | Newton's third law of motion |
| Option D: | Law of conservation of mass |
| | |
| 5. | A surface profile is a measure of _____ |
| Option A: | Temperature changes |
| Option B: | Pressure changes |
| Option C: | Flow changes |
| Option D: | Volumetric changes |
| | |
| 6. | In Inward radial flow reaction turbine if angle made by absolute velocity with its tangent is 90 degrees and component of whirl is zero at outlet is _____ |
| Option A: | Radial inlet discharge |
| Option B: | Radial outlet discharge |

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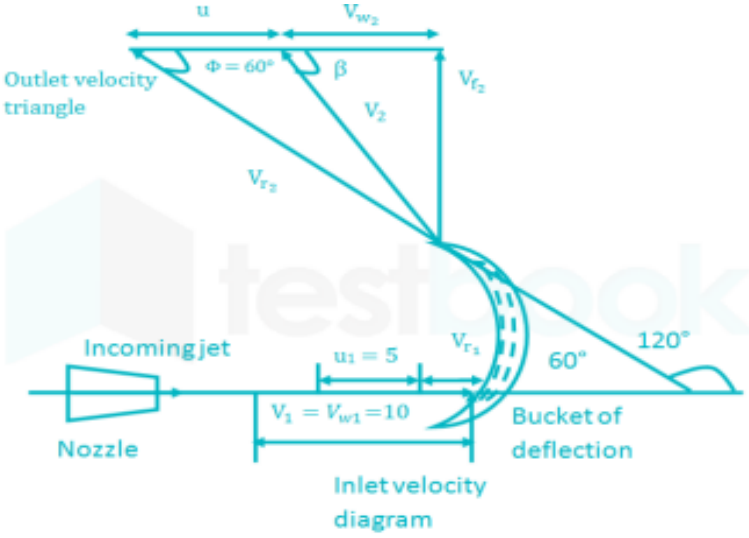
|---|---|
| Option C: | Flow ratio |
| Option D: | Speed ratio |
| | |
| 7. | The formation of vapour cavities is called _____ |
| Option A: | Static pressure drop |
| Option B: | Cavitation |
| Option C: | Isentropic expansion |
| Option D: | Emulsion |
| | |
| 8. | Energy per unit weight of water measured with respect to the datum is called as _____ |
| Option A: | Total energy |
| Option B: | Specific energy |
| Option C: | Velocity head |
| Option D: | Datum head |
| | |
| 9. | The velocity of the flow through the Kaplan turbine is 25m/s. The available head of the turbine is 60m. Find the flow ratio of the turbine (take g= 10m/s2). |
| Option A: | 0.65 |
| Option B: | 0.72 |
| Option C: | 0.69 |
| Option D: | 0.80 |
| | |
| 10. | The working of which of the following hydraulic units is based on Pascal's law? |
| Option A: | Air lift pump |
| Option B: | Hydraulic coupling |
| Option C: | Hydraulic press |
| Option D: | Jet pump |

# Option 1

| **Q2.** | **Solve any Four out of Six** **5 marks each** |
|---|---|
| A | Define the specific speed of a turbine. Derive an expression for the specific speed |
| B | Compare between impulse turbine and reaction turbine. |
| C | Derive the condition for maximum efficiency of the wheel (series of vanes), using that condition what is the maximum possible efficiency value? |
| D | The loss of energy head in a hydraulic jump is 4.25 m. The Froude number just before the jump is 7.50. Find i) discharge per meter width of the channel ii) depths before & after hydraulic jumps iii) Froude number after the jump iv) Percentage loss of energy head due to the jump. |
| E | Determine the length of the back water curve caused by afflux of 2m in rectangular channel of width 40m and depth 2.5m. The slope of bed is given as 1*in*11000. Take Manning's N = 0.03 |
| F | The following data is given for a Francis turbine, Net Head H = 70 m; speed N= 600 r.p.m.; shaft power = 367.875 kW; overall efficiency of 85% hydraulic efficiency = 95%; flow ratio = 0.25; breadth ratio, n= 0.1; outer diameter of the runner = 2 x inner diameter of the runner. The thickness of |

| | |
|---|---|
| | vanes occupy 10% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet.<br>Determine: i. The guide blade angle,Runner vane angles at inlet and outlet<br>ii. Diameter of runner at inlet and outlet, and Width of wheel at inlet |

| **Q3.** | **Solve any Four out of Six** **5 marks each** |
|---|---|
| A | Derive conditions for the most economical trapezoidal channel section |
| B | Derive expression for force exerted by jet on stationary curved plate when jet striking at Centre. |
| C | The discharge of water through a rectangular channel of width 6m, is 18 m3/s when depth of flow of water is 2 m calculate: a) Specific energy of flowing water , b) critical depth and critical velocity , c) value of minimum specific energy |
| D | What do you understand about the characteristics curves of a turbine? State and draw the important types of characteristics curves |
| E | Two geometrically similar pumps are run at the same speed of 1000 rpm. One pump has an impeller diameter of 0.30 m & lifts water at the rate of 20 liters per second against a head of 15 m. Determine the head & impeller diameter of other pump to deliver half the discharge. |
| F | The inner & outer diameters of an inward flow reaction turbine are 1.25 m & 1.60 m respectively. The vane angle at the inlet is 95°, while the guide blade angle is 22°30'. The axial depth of the wheel of inlet & outlet is 0.50 m. The turbine runs at 150 rpm. Determine i) The discharge of the turbine; ii)The outlet vane angle; iii) Shaft power. |

| **Q4.** | **Solve any Four out of Six** **5 marks each** |
|---|---|
| A | Explain term hydraulic jump. Drive an expression for the depth of hydraulic jump in term of the upstream Froude number. |
| B | Find the power required to drive a centrifugal pump which deliverers 0.04m3/s of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of Pump is 70% and coefficient of friction $f = 0.015$ |
| C | Find work done, power, and efficiency by using figure given below (if required assume additional data)<br>  |
| D | Draw Velocity profile for following cases |

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|---|---|
| | i) Impulse Turbine & Reaction Turbine<br>ii) Inward & Outward radial flow reaction turbine<br>iii) Axial flow Reaction Turbine |
| E | A 3 m wide rectangular channel conveys 12 cumecs of water at a depth of 2m. Calculate i) Specific energy of flowing fluid; ii) Critical depth, critical velocity and the minimum specific energy; iii) Froude's Number. |
| F | Write a note on multistage pump |