

Enrollment No.....



Faculty of Engineering
End Sem (Odd) Examination Dec-2022
CE3CO10 Hydraulics & Hydraulic Machines

Programme: B.Tech.

Branch/Specialisation: CE

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. Eddy viscosity is a turbulent transfer of _____. 1
 (a) Fluid (b) Heat
 (c) Momentum (d) Pressure
- ii. The steady- state flow must satisfy _____. 1
 (a) Kirchhoff's law (b) Newton's law
 (c) Rutherford's experiment (d) Kepler's law
- iii. Calculate the mean hydraulic depth of a channel having top width of 7m and cross-sectional area of 35m². 1
 (a) 4m (b) 5m (c) 6m (d) 7m
- iv. Calculate the side slope of a trapezoidal channel section having base 8m, depth 4m and the hydraulic radius is 2.36m. 1
 (a) 1/6 (b) 1/3 (c) 1/2 (d) 1/4
- v. Which of the following assumptions about a GVF is false? 1
 (a) Channel is prismatic.
 (b) Pressure distribution is hydrostatic.
 (c) Flow characteristics change with time.
 (d) Roughness coefficient is constant.
- vi. The compressible flow is assumed to be _____. 1
 (a) Isentropic (b) Adiabatic
 (c) Polytropic (d) Both (a) and (b)
- vii. Fluid speed before the hydraulic jump is _____. 1
 (a) Critical (b) Super critical
 (c) Sub critical (d) Dynamic

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- viii. Fluid height before the hydraulic jump is _____. **1**
 (a) Normal (b) Low (c) High (d) Zero
- ix. Hydraulic energy is converted into another form of energy by hydraulic machines. What form of energy is that? **1**
 (a) Mechanical energy (b) Electrical energy
 (c) Nuclear energy (d) Elastic energy
- x. Which among the following control the flow rate? **1**
 (a) Valve (b) Pump (c) Head (d) Tank pipe
- Q.2 i. What is prandtl's mixing length theory? **2**
 ii. What is meant by boundary layer? Why does it increase with distance from the upstream edge? **3**
 iii. A thin plate is moving in still atmospheric air at a velocity of 5m/s. The length of the plate is 0.6m and width 0.5m. Calculate: **5**
 (a) The thickness of the boundary layer at the end of the plate
 (b) Drag force on one side of the plate.
 Take density of air as 1.24kg/m³ and kinematics viscosity 0.15 stokes.
- OR iv. Determine the thickness of the boundary layer at the trailing edge of smooth plate of length 4m and of width 1.5m, when the plate is moving with a velocity of 4m/s in stationary air. Take kinematic viscosity of air as 1.5*10⁻⁵ m²/s. **5**
- Q.3 i. What is the relation between Manning's constant and Chezy's constant? **2**
 ii. Derive the condition for the best side slope of the most economical trapezoidal section and also derive hydraulic mean depth must be equal to half the depth of flow. **8**
- OR iii. Find the discharge through a rectangular channel 14m wide, having a depth of water 3m and bed slope 1 in 1500. Take the value of N= 0.03 in the Kutter's formula. **8**
- Q.4 i. Explain the terms: **3**
 (a) Critical flow (b) Sub-critical flow
 (c) Super-critical flow

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- ii. What is specific energy curve? Draw specific energy curve and then derive expression for critical depth and critical velocity. **7**
- OR iii. Derive an equation of gradually varied flow. **7**
- Q.5 i. Explain in brief rapidly varied flow. **4**
 ii. Explain the term hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number. **6**
- OR iii. Explain the terms: **6**
 (a) Energy dissipation (b) Positive surges
 (c) Negative surges
- Q.6 Attempt any two: **5**
 i. A pelton wheel is to be designed for the following specifications: **5**
 shaft power= 11772 kW, Head= 380 m., speed= 750 rpm, overall efficiency =86%, jet diameter is not to exceed one sixth of the wheel diameter. Determine:
 (a) The wheel diameter (b) The number of jets required
 (c) Diameter of the jet.
 (Take K_v= 0.985 and K_{u1}= 0.45)
- ii. Differentiate between: **5**
 (a) The impulse and reaction turbine
 (b) Centrifugal and reciprocating pump
- iii. The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400mm respectively, the pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. **5**

Marking Scheme
CE3CO10 Hydraulics & Hydraulic Machines

Q.1	i	Eddy viscosity is a turbulent transfer of _____ c)Momentum	1
	ii	The steady- state flow must satisfy _____ a)Kirchhoff's law	1
	iii	Calculate the mean hydraulic depth of a channel having top width of 7m and cross sectional area of 35m ² . b)5m	1
	iv	Calculate the side slope of a trapezoidal channel section having base 8m, depth 4m and the hydraulic radius is 2.36m. c)1/2	1
	v	Which of the following assumptions about a GVF is false? (c) Flow characteristics change with time.	1
	vi	The compressible flow is assumed to be _____ a)Isentropic	1
	vi	Fluid speed before the hydraulic jump is _____ b)Supercritical	1
	viii	Fluid height before the hydraulic jump is _____ b)Low	1
	ix	Hydraulic energy is converted into another form of energy by hydraulic machines. What form of energy is that? (a) Mechanical energy	1
	x	Which among the following control the flow rate? a)Valve	1
Q.2	i	What is prandtl's mixing length theory? prandtl's mixing length theory	2
	ii	What is meant by boundary layer? Why does it increase with distance from the upstream edge? Definition boundary layer concept	3
	iii	A thin plate is moving in still atmospheric air at a velocity of 5m/s. The length of the plate is 0.6m and width 0.5m. Calculate i) the thickness of the boundary layer at the end of the plate and	5

		ii) drag force on one side of the plate. Take density of air as 1.24kg/m ³ and kinematics viscosity 0.15 stokes. Formula Description	5
OR	iv	Determine the thickness of the boundary layer at the trailing edge of smooth plate of length 4m and of width 1.5m.when the plate is moving with a velocity of 4m/s in stationary air. Take kinematic viscosity of air as 1.5*10 ⁻⁵ m ² /s. Formula Solution description	5
Q.3	i	What is the relation between Manning's constant and Chezy's constant. Manning's constant Chezy's constant	2
	ii	Derive the condition for the best side slope of the most economical trapezoidal section and also derive hydraulic mean depth must be equal to half the depth of flow. Diagram Derivation	8
OR	iii	Find the discharge through a rectangular channel 14m wide, having a depth of water 3m and bed slope 1 in 1500. Take the value of N= 0.03 in the kutter's formula. Diagram Formula Solution description	8
Q.4	i	Explain the terms: i) Critical flow ii) Sub-critical flow ii) Super-critical flow Critical flow Sub-critical flow Super-critical flow	3
	ii	What is specific energy curve? Draw specific energy curve and then derive expression for critical depth and critical velocity? Definition specific energy curve specific energy curve	7
OR	iii	Derive an equation of gradually varied flow? Diagram Derivation	7

Q.5	i.	Explain in brief Rapidly varied flow. Definition -04 marks	4
	ii.	Explain the term Hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number. Diagram -01 marks Derivation -05 marks	6
OR	iii.	Explain the terms: i) Energy dissipation ii) Positive surges iii) negative surges Energy dissipation -02 marks Positive surges -02 marks Negative surges -02 marks	6
Q.6		Attempt any two:	
	i	A pelton wheel is to be designed for the following specifications: shaft power= 11772 kW, Head= 380 m., speed= 750 rpm, overall efficiency =86%, jet diameter is not to exceed one sixth of the wheel diameter. Determine: i) The wheel diameter ii) The number of jets required iii) Diameter of the jet.(Take $K_v = 0.985$ and $K_{u1} = 0.45$) Diagram -01 mark Formula -01 mark Solution description -03 marks	5
	ii	Differentiate between: i) The impulse and reaction turbine ii) Centrifugal and reciprocating pump Impulse and reaction turbine -2.5 marks Centrifugal and reciprocating pump -2.5 marks	5
	iii	The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400mm respectively, The pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. Diagram -01 mark Formula -01 mark Solution description -03 marks	5
