Enrollment No.....................................

Faculty of Engineering
End Sem (Odd) Examination Dec-2019
CE3CO10 Hydraulics and 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.   Assume a turbulent flow of a fluid on a flat plate. A very thin region near the plate surface is called as   **1**
(a) Laminar buffer layer   (b) Laminar sublayer
(c) Laminar turbulent layer   (d) None of these

ii.   The concept of the hydrodynamic boundary layer was first suggested by   **1**
(a) Isaac Newton   (b) Ludwig Prandtl
(c) Rodridge   (d) Fourier

iii.   Calculate the mean hydraulic depth of a channel having top width of 7m and cross-sectional area of 35m2.   **1**
(a) 4 m   (b) 5 m   (c) 6 m   (d) 7 m

iv.   The flow characteristics of a channel do not change with time at any point. What type of flow is it?   **1**
(a) Steady flow   (b) Uniform flow
(c) Laminar flow   (d) Turbulent flow

v.   The ratio of inertia force and gravitational force is called as _____   **1**
(a) Reynolds number   (b) Stokes number
(c) Froude's number   (d) Euler's number

vi.   Calculate the Froude's number for a channel having discharge of $261.03 m^3/s$, cross sectional area of $42 m^2$ and the top width being 6m.   **1**
(a) 0.65   (b) 0.72   (c) 0.38   (d) 0.75

vii.   Hydraulic jump depends upon   **1**
(a) Temperature   (b) Pressure
(c) Initial fluid speed   (d) Volumetric changes

viii. Fluid height before the hydraulic jump is _____ **1**
(a) Normal   (b) Low   (c) High   (d) Zero

ix. Which kind of turbines changes the pressure of the water entered **1**
through it?
(a) Reaction turbines   (b) Impulse turbines
(c) Reactive turbines   (d) Kinetic turbines

x. Which principle is used in Hydraulic Turbines? **1**
(a) Faraday law   (b) Newton's second law
(c) Charles law   (d) Braggs law

Q.2 i. Define momentum thickness and energy thickness. **2**
ii. Derive the expression of displacement thickness **3**
iii. Explain the phenomenon of boundary layer separation **5**
OR iv. The velocity distribution in the boundary layer is given by **5**

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

Calculate: Displacement thickness, Momentum thickness, Energy thickness

Q.3 i. Explain velocity distribution in open channel flow. Also list out the **4**
types of open channels.
ii. Derive all the conditions of most economical trapezoidal section. **6**
OR iii. A trapezoidal channel has side slopes of 1 horizontal to 2 vertical **6**
and the slope of the bed is 1 in 5000. The area of the section is 40
m². If Chezy's constant C = 60, determine the optimum dimensions
of the section and discharge in the channel

Q.4 i. Derive expression for critical depth and critical velocity in a **4**
rectangular channel.
ii. State the assumptions and derive the dynamic equation of gradually **6**
varied flow.
OR iii. A wide channel laid to a slope of 1 in 1000 carries a discharge of 3.5 **6**
m³/s per meter width at a depth of 1.6 m. Find out the value of
Chezy's constant C. Consider the flow to be uniform.
If the actual depth varies from 1.5 m at an upstream location to 1.7m

at downstream, what will be the value of Chezy's constant.

Q.5 i. List out the types of hydraulic jump with their Froude's number. **2**
ii. Define Hydraulic jump. What are the assumptions made in the **8**
analysis of hydraulic jump? Derive the expression for the height of
the hydraulic jump.
OR iii. Define Surge in open channel. Explain the types of Surges. Derive **8**
the expressions for positive surge.

Q.6 Attempt any two:
i. List out the components and explain the working of Reciprocating **5**
pump.
ii. List out the components and explain the working of Kaplan turbine. **5**
iii. Write a short note on classification of pump giving suitable example **5**
of their use.

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Marking Scheme

CE3CO10 Hydraulics and Hydraulic Machines

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Q.1　i.　Assume a turbulent flow of a fluid on a flat plate. A very thin region　**1**
　　　near the plate surface is called as
　　　(b) Laminar sublayer

　　ii.　The concept of the hydrodynamic boundary layer was first　**1**
　　　suggested by
　　　(b) Ludwig Prandtl

　　iii.　Calculate the mean hydraulic depth of a channel having top width of　**1**
　　　7m and cross-sectional area of 35m2.
　　　(b) 5 m

　　iv.　The flow characteristics of a channel do not change with time at any　**1**
　　　point. What type of flow is it?
　　　(a) Steady flow

　　v.　The ratio of inertia force and gravitational force is called as _____　**1**
　　　(c) Froude's number

　　vi.　Calculate the Froude's number for a channel having discharge of　**1**
　　　261.03m^3/s, cross sectional area of 42m^2 and the top width being 6m.
　　　(d) 0.75

　　vii.　Hydraulic jump depends upon　**1**
　　　(c) Initial fluid speed

　　viii.　Fluid height before the hydraulic jump is _____　**1**
　　　(b) Low

　　ix.　Which kind of turbines changes the pressure of the water entered　**1**
　　　through it?
　　　(a) Reaction turbines

　　x.　Which principle is used in Hydraulic Turbines?　**1**
　　　(b) Newton's second law

Q.2　i.　Momentum thickness　　　　　　　　　　1 mark　　**2**
　　　Energy thickness.　　　　　　　　　　　1 mark
　　ii.　Displacement thickness　　　　　　　　　　　**3**
　　　Expression　　　　　　　　　　　　　1 mark
　　　Derivation　　　　　　　　　　　　　2 marks
　　iii.　Phenomenon of boundary layer separation　　　　　　**5**
OR　iv.　Displacement thickness, Momentum thickness, Energy thickness　**5**
　　　All Correct formulas　　　　　　　　　1 mark
　　　For correct procedure　　　　　　　　2 marks
　　　For correct solution　　　　　　　　　2 marks

Q.3　i.　Velocity distribution in open channel flow　　2 marks　　**4**
　　　Types of open channels
　　　0.5 mark for each (0.5 mark * 4)　　　　2 marks
　　ii.　Conditions of most economical trapezoidal section.　　**6**
　　　3 marks for each condition　　　　　(3 marks * 2)
OR　iii.　Determine the optimum dimensions of the section and discharge in　**6**
　　　the channel
　　　All Correct formulas　　　　　　　　1 mark
　　　For correct procedure　　　　　　　　2 marks
　　　For correct solution　　　　　　　　　3 marks

Q.4　i.　Expression for critical depth　　　　　2 marks　　**4**
　　　Expression for critical velocity　　　　2 marks
　　ii.　Dynamic equation of gradually varied flow.　　**6**
　　　Assumptions　　　　　　　　　　　2 marks
　　　Derivation　　　　　　　　　　　　4 marks
OR　iii.　Find out the value of Chezy's constant C.　　**6**
　　　All Correct formulas　　　　　　　　1 mark
　　　For correct procedure　　　　　　　　2 marks
　　　For correct solution　　　　　　　　　3 marks

Q.5　i.　Types of hydraulic jump with their Froude's number.　　**2**
　　　0.5 mark for each　　　　　　　　　(0.5 mark * 4)
　　ii.　Definition of Hydraulic jump　　　　　1 mark　　**8**
　　　Assumptions made in the analysis of hydraulic jump 2 marks
　　　Derivation for the height of the hydraulic jump　5 marks.
OR　iii.　Definition of Surge in open channel　　　1 mark　　**8**
　　　Types of Surges 0.5 mark for each (0.5 mark * 6)　3 marks
　　　Derivation for positive surge　　　　　5 marks

Q.6　　Attempt any two:
　　i.　Working of Reciprocating pump.　　　　2 marks　　**5**
　　　Components　　　　　　　　　　　2 marks
　　　Diagram　　　　　　　　　　　　1 mark
　　ii.　Working of Kaplan turbine　.　　　　　2 marks　　**5**
　　　Components　　　　　　　　　　　2 marks
　　　Diagram　　　　　　　　　　　　1 mark
　　iii.　Classification of pump　　　　　　　3 marks　　**5**
　　　Example of their use　　　　　　　　2 marks

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