SE402

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S.E. (Civil) (Sem-IV) (Revised Course 2016-2017)
EXAMINATION Nov/Dec 2019
Fluid Mechanics - II

[Duration : Three Hours] **[Total Marks : 100]**

Instructions:

1) Marks are indicated to the right of the questions.
2) Answer any 2 question from part **A & B** and one questions from part **C**.
3) Assume additional data if required and state them clearly

PART - A

Q.1

a) What do you mean by 'most economical section' of an open channel? Prove that for a most economical trapezoidal section half of top width is equal to its length of one of the sloping sides. **08**

b) Compare the velocity distribution of turbulent flow laminar flow occurring through pipes. **04**

c) A jet of water 60mm diameter strikes a curved vane at its centre with a velocity of 18m/s. The curved vane is moving with a velocity of 6m/s in the direction of the jet. The jet is deflected through an angle of 165° . Assuming the plate to be smooth find: **08**

i) Force on the plate in the direction of jet.
ii) Work done per second by the jet on the vane.
iii) Efficiency of the jet.

Q.2

a) A rectangular channel is 1m wide and the discharge of water through it is estimated to be 1530 m^3/hr. The depth of flow at a section is 10cm. If a hydraulic jump occurs, Calculate i) Froude number before and after the jump, ii) height and length of the jump, iii) Loss of energy in jump, iv) Power dissipated. **07**

b) What is meant by a smooth boundary and a rough boundary? **03**

c) A square plate weighing 120N and 30cm length is hung using a hinge so that a horizontal jet of water, 2.5cm in diameter and having velocity of 15m/s impinges on the plate. The centre line of the jet is 15cm below the upper edge of the plate , and when the plate is vertical the jet strikes the plate normally. **10**

i) What force must be applied at the lower edge of the plate in order to keep the plate vertical?
ii) If the plate is allowed to swing freely, compute the inclination to the vertical which the plate will attain under the action of jet.

Q.3

a) A concrete lined circular channel of 3.6 m diameter has a bed slope of 1 in 600. Determine the velocity and flow rate for the conditions of maximum velocity and maximum discharge . C= 50 **10**

b) A smooth pipe of 80mm diameter and 1 km long is carrying water at the rate of 8 litres/s. If the kinematic viscosity is 0.015 stokes and the value of coefficient of friction 'f' is given by $f = \frac{0.0791}{(Re)^{\frac{1}{4}}}$ **10**

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Determine i) Loss of head.
ii) Wall shearing stress.
iii) Centre line velocity.
iv) Velocity and shear stress at 20mm from the pipe wall.
v) Thickness of laminar sub layer.

PART – B

Q.4

a) Explain the term priming related to centrifugal pump. why priming is necessary for a centrifugal pump. **04**

b) A Pelton wheel is receiving water from a penstock with a gross head of 510m. One third of the gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2 m^3/s. The angle of deflection of the jet is 165° **10**
Determine : i) The power given by the water to the runner
ii) Hydraulic efficiency of the Pelton wheel.
co – efficient of velocity = 1.00 and speed ratio = 0.45

c) With the help of a neat diagram explain the working of Hydraulic ram. **06**

Q.5

a) Draw a neat sketch of a reciprocating pump indicating its various components . **05**

b) Derive an expression for minimum starting speed of a centrifugal pump. **05**

c) A centrifugal pump having outer diameter equal to twice the inner diameter and running at 1000rpm works against a total head of 40m. The velocity of flow through the impeller is constant and equal to 2.5m/s. The vanes are set back at an angle of 40° at the outlet. If the outer diameter of the impeller is 500mm and width at the outlet is 50mm, Determine **10**
i) Vane angle at inlet.
ii) Work done by impeller on water per sec.
iii) Manometric efficiency.

Q.6

a) Explain the working of a Double acting reciprocating pump. In a double acting reciprocating pump having piston area $0.1m^2$ has a stoke 0.3 m long. The pump is discharging 2.4 m^3 of water per minute at 45 rpm through a height of 10m. Find the slip of the pump and the power required to drive the pump. **10**

b) What is cavitation in turbines? What are the causes of cavitation? Explain the steps to be taken to avoid cavitation. **10**

PART – C

Q.7

a) Explain the characteristics of steep slope flow profiles. A wide rectangular channel with a bottom width of 4m and a bottom slope of 0.0008 has a discharge of $1.5m^3/s$. In a gradually varied flow in this channel, the depth at a certain location is found to be 0.30m. Assuming Manning's constant N= 0.016, determine the type of gradually varied flow profile . **10**

b) with a note on **10**
i) Hydraulic jack.
ii) Safety measures in hydroelectric power plants.

Q.8

a) A Francis turbine is supplied $0.233 m^3/s$ of water under a head of 11m. The wheel vanes are radial at inlet and the inlet diameter is twice the outlet diameter. The velocity of flow is constant and equal to 1.83 m/s. The wheel makes 370rpm. Assume discharge is radial and there are no losses in wheel. Speed ratio =0.7 **10**

Neglect the thickness of vanes.

Determine i) Guide vane angle

ii) Inlet and outlet diameters of the wheel

iii) The width of the wheel at inlet and exit.

b) With the help of specific energy curve explain transition in channel by **10**

i) Introducing a hump .

ii) Reduction in channel width.

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