315(S)

December 2016

HYDRAULICS (FOR CE)

Time Allowed: 3 Hours   *Full Marks: 70*

Answer to Question No.1 is compulsory and to be answered first.
This answer is to be made in separate loose script(s) provided for the purpose.
Maximum time allowed is 45 minutes, after which the loose answer scripts will be collected and
fresh answer scripts for answering the remaining part of the question will be provided.
On early submission of answer scripts of Question No.1,
a student will get the remaining script earlier.

Answer _any five_ questions from the rest.
Answer should not be bilingual.
To the point answer will be given additional credit.

1.   A.   Answer _any ten_ questions: 10×1

      i)   Define Hydrodynamics.

      ii)   SI unit of Kinematic Viscosity is _____.

      iii)   What are the discharge measuring devices for channels?

      iv)   When the valve at the end of a pipeline is closed rapidly, the time (T) required for the pressure wave to travel the whole of length L of pipe and return to stop valve is given by _____ where L = length of pipe, and C = true velocity of compressive wave.

      v)   The two-point method of measurement of velocity is the average velocity as – (a) $\dfrac{v_{0.2d}+v_{0.6d}}{2}$, (b) $\dfrac{v_{0.4d}+v_{0.8d}}{2}$, (c) $\dfrac{v_{0.2d}+v_{0.4d}}{2}$, (d) $\dfrac{v_{0.2d}+v_{0.8d}}{2}$.

      vi)   A control volume is – (a) the volume of fluid flowing per unit of time, (b) a volume fixed in space, (c) the volume in which a control device is situated, (d) the volume of the fluid controlling device.

      vii) The flow in a river during the period of heavy rainfall is – (a) steady; non-uniform and three-dimensional, (b) steady, uniform, two-dimensional, (c) unsteady, uniform, three-dimensional, (d) unsteady, non-uniform and three-dimensional.

      viii) Loss of head due to sudden contraction is given as – (a) $\dfrac{V_2}{g}\left(\dfrac{1}{C_c}-1\right)^2$, (b) $\dfrac{V_2^{\,2}}{2g}\left(\dfrac{1}{C_c}-1\right)^2$, (c) $\dfrac{V_2}{g^2}\left(\dfrac{1}{C_c}-1\right)^2$, (d) $\dfrac{V_2^{\,2}}{2g}\left(\dfrac{1}{C_c}-1\right)$.

      ix)   The critical depth in a rectangular channel is given by _____, where q = discharge per unit width.

      x)   In order to avoid a correction for the effect of capillarity in manometers used for measuring pressure, the diameter of tube should be – (a) less than 3 mm, (b) more than 3 mm but less than 5 mm, (c) equal to 5 mm, (d) greater than or equal to 6 mm.

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xi) The function of a surge tank is to _____ .

xii) Maximum discharge over a broad-crested weir is given by _____ where the symbols Q, L, H bear usual meanings.

xiii) What is reciprocating pump?

B. Answer any five questions: 5×2

i) Write Francis's discharge measuring formula for a rectangular weir with n end contractions.

ii) What is meant by gauge pressure?

iii) What are the different types of current meters used for measuring velocity in open channel?

iv) State Dupuit's equation.

v) A 0.5 m diameter and 100 m long pipeline carrying 0.5 m³/s of water is a fitted with a valve at the downstream end. Calculate the rise of pressure caused within the pipe due to valve closure instantaneously.

vi) Define Laminar Flow.

vii) At a hydraulic jump, the depths at two sides are 0.4 m and 1.4 m. The head loss in the jump is nearly _____ .

viii) Classify weirs according to the shape of the crest.

2. a) Write in brief about viscosity and surface tension.
   b) Observations for discharge measurement taken on a stream by float method are as follows:
   Number of segments = 5
   Depth of flow observed at the centre of each segments (m): 0.75, 1.20, 1.75, 1.35, 0.60
   Width of the stream at the water surface = 19.70 m
   Width of each segment (m) = 3.1, 4.5, 5.0, 4.3, 2.8
   Distance between the two cross sections = 100 m
   Time taken by the surface floats in each segment is as follows:

Segment	Minutes	Seconds
1	2	11
2	1	45
3	1	40
4	1	55
5	2	09

   Find the discharge flowing in the stream. (3+2)+5

3. a) Define Specific Gravity of a liquid.
   b) On two sides of a bulkhead, there are oils of specific gravity 0.70 and 0.80 respectively. The height of the former is 4 m from the base of the bulkhead and the height of the latter is 2 m from the base of the bulkhead. Draw pressure diagrams for both the oils and determine: (i) resultant total pressure on the bulkhead per metre of its length; (ii) the point of application of the resultant pressure. 2+8

4. a) A two-dimensional jet of water of thickness 10 cm and issuing with a velocity of 10 m/s strikes a stationary plate at an angle of 30° to the normal of the plate, (i) Calculate the force on the plate, (ii) Estimate the discharge of the two streams that move on the plate on either side of the impact zone.
   b) Find the discharge over an Ogee weir 6 m long and having a head of 0.4 m of water. Take $C_d = 0.62$. 7+3

5. a) What are the uses and limitations of Flow-net.
   b) The data pertaining to a stream-gauging operation at a gauging site are given below:

Distance from left water edge (m)	0	1.0	3.0	5.0	7.0	9.0	11.0	12.0
Depth (m)	0	1.1	2.0	2.5	2.0	1.7	1.0	0
Revolutions of a current meter kept at 0.6 depth	0	39	38	112	90	45	30	0
Duration of observation (s)	0	100	100	150	150	100	100	0

The rating equation of the current meter is $v = 0.51 N_s + 0.03$ m/s.
Calculate the discharge in the stream. 4+6

6. a) State Froude No. and its significance.
   b) Define Critical Flow.
   c) Water flows at 1 m³/sec along a channel of rectangular section 1.75 m in width. Calculate the critical depth. If a hydraulic jump is formed at a point where the upstream depth is 0.25 m, what would be the rise in water level? 3+1+6

7. a) Define Suction head, Delivery head, static head and manometric head of a centrifugal pump.
   b) The inlet to pump is 10.5 m above the bottom of sump from which it draws water through a suction pipe. If the pressure at the pump inlet is not to fall below 28 kN/m² absolute, work out the minimum depth of water in the tank. Assume atmospheric pressure as 100 kPa. 6+4

8. a) Differentiate between pump and turbine.
   b) Water flows over a rectangular sharp crested weir 1.0 m long, the head over the sill of the weir being 0.66 m. The approach channel is 1.4 m wide and the depth of flow in the channel is 1.2 m. Determine the rate of discharge over the weir. Consider the effect of end contractions. Take the coefficient of discharge for the weir as 0.60. Determine also the rate of discharge over the weir considering the effect of end contractions and velocity of approach. 3+7