December 2018

315(S)

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 <u>any five</u> questions from the rest.

1. Choose the correct answer from the given alternatives (any twenty): 20x1

i) Falling drops of rain acquire spherical shape on account of – a) viscosity b) surface tension c) vapour pressure d) compressibility.

ii) Unit of viscosity in SI system is – a) N-sec/m^2 b) Poise c) Kgf-sec/m^2 d) none of the above.

iii) An ideal fluid is one which is – a) compressible and non-viscous b) incompressible and viscous c) incompressible and non-viscous d) none of the above.

iv) The specific weight of fresh water under normal conditions in SI units is – a) 981 x 10^3 N/m^3 b) 98.1 x 10^3 N/m^3 c) 9.81 x 10^3 N/m^3 d) none of the above.

v) Pressure at a point in a static mass of liquid depends upon – a) the shape and size of bounding container b) the depth below the liquid surface c) the specific weight of the liquid and depth below the free liquid surface d) none of the above.

vi) Select the correct statement – a) Absolute Pressure = Gauge Pressure – Atmospheric Pressure b) Absolute Pressure = Atmospheric Pressure + Vacuum Pressure c) none of the above.

vii) A Pitot tube is an instrument for measuring – a) Pressure of flow b) Discharge of fluid c) Velocity of flow d) Total energy.

viii) Location of centre of pressure in such that it is almost always – a) below the centroid of the plane surface b) above the centroid of the plane surface c) at the centre of buoyancy d) none of the above.

ix) The intensity of pressure for a fluid at rest is equal in all directions is known as – a) Newton's law of viscosity b) Pascal's law c) Archimedes principle d) none of the above.

x) The Continuity equation is based on – a) conservation of mass b) conservation of energy c) velocity potential d) none of these.

xi) If the fluid characteristics such as density, velocity etc, do not change with time the flow is – a) steady b) unsteady c) laminar d) turbulent.

xii) Flow of water is said to be Turbulent flow when Reynold's number exceeds more than – a) 2000 b) 2400 c) 4000 d) none of these.

xiii) Bernoulli's theorem deals with the law of conservation of – a) mass b) momentum c) energy d) none of these.

xiv) For pipe flow loss at entrance in the pipe is given by – a) V^2 / g b) $0.5V / g$ c) $2V^2 / g$ d) d) none of the above.

xv) Darcy Weisbatch formula for frictional head loss in pipe length L is expressed by – a) $h_f = 4fLv^2/2gd$ b) $h_f = fLv^2/2gd$ c) $h_f = fLv^2/gd$ d) none of these.

xvi) The loss of head due to sudden enlargement in a pipe is expressed by – a) $V_1^2 - V_2^2 / 2g$ b) $V_1^2 + V_2^2 / 2g$ c) $(V_1 - V_2)^2 / 2g$ d) $(V_1 - V_2) / 2g$.

xvii) A curve traced by a single fluid particle during its motion is a – a) stream line b) path line c) unsteady flow d) non-uniform flow.

xviii) Flow in a pipe whose valve is being opened or closed gradually is an example of – a) uniform flow b) steady flow c) unsteady flow d) non-uniform flow.

xix) The energy loss in pipes is due to – a) viscous action only b) surface roughness only c) friction offered by pipe wall as well as by viscous action d) turbulent shear stress only.

xx) For a circular channel of diameter 'd' flowing half full the mean hydraulic depth will be – a) d/4 b) d/2 c) d d) is independent of 'd'.

xxi) The energy of a flow undergoing a hydraulic jump – a) reduces after jump b) increases after jump c) remains same d) none of these.

xxii) The chezy's equation for flow in open channel is given by – a) $V = C.R.S^{(1/2)}$ b) $V = C.(RS)^{(1/2)}$ c) $V = S.(CR)^{(1/2)}$ d) none of the above.

xxiii) Open channel flow is caused by – a) Gravity b) atmospheric pressure c) frictional forces d) none of these.

xxiv) Hydraulic jump occurs in the – a) U/S side of a dam b) D/S side of a dam c) top surface of the dam d) all of these.

xxv) The discharge through a V-notch varies as – a) $H^{1/2}$ b) H c) $H^{3/2}$ d) $H^{5/2}$.

xxvi) The discharge through a rectangular weir varies as – a) $H^{3/2}$ b) $H^{1/2}$ c) $H^{5/2}$ d) H.

xxvii) The orifice meter is used for measuring – a) the flow of fluid in a pipe b) the velocity of fluid in a pipe c) the total energy in a pipe d) none of the above.

xxviii) Reciprocating pumps are suitable for – a) low discharge and high head b) low discharge and low head c) high discharge and low head d) high discharge and high head.

(2) a) Write in brief about – i) Compressible flow ii) Uniform flow, iii) Laminar flow, iv) Turbulent flow, v) Continuity equation.

b) State Bernoulli's theorem. Write down the assumptions of Bernoulli's equation.

c) The velocity potential function is given by $\varphi = 5 (x^2 - y^2)$ .Calculate the velocity components at the point (4, 5).

5+3+2

(3) a) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is 4m at a higher level. I the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200litres. Determine the loss of head and direction of flow.

b) Write down Darcy weisbach formula for loss of energy due to friction.

c) A 150 mm diameter pipe reduces in diameter abruptly to 100 mm diameter. If the pipe carries water at 30 litres per second, calculate the pressure loss across the contraction. Take coefficient of contraction as 0.62.

5+2+3

4. a) What is the condition for most economical rectangular section for an open channel flow?
b) Write in short about critical depth and critical velocity.
c) What is Hydraulic gradient line and Total energy line?
d) An oil of sp.gr.0.8 is flowing through a Venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal Venturimeter. Take $c_d = 0.98$. 2+2+2+4

5. a) Water flows through a pipe AB is 1.2 m diameter at 3m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches, branch CD is 0.8 m in diameter and carries one third of flow in AB.The flow velocity in branch CE is 2.5 m.Find the volume rate of flow in AB, the velocity the velocity in BC and CD and diameter of CE.
b) The specific energy for a 5 m wide rectangular channel is to be 4 Nm/N. If the rate of flow of water through the channel is 20 m^3/s. Determine the alternate depths of flow. 5+5

6. a) The surface tension of water in contact with air is 20^0 C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water.
b) Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in – i) water and ii) mercury. Take surface tension σ = 0.0725 N/m for water and σ = 0.52 N/m for mercury is given as 13.6 and angle of contact = 130^0. 5+5

7. a) A flat plate of area 1.5×10^6 mm^2 is pulled with a speed of 0.4 m/s relative to another plate located at a distance of 0.15 mm from it Find the force and power required to maintain this speed, if the fluid separating them is having viscosity 1 poise.
b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 metre per sec requires a force of 98.1 N to maintain the speed. Determine – i) the dynamic viscosity of the oil in poise & ii) the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95. 5+5

8. a) A square plate with 1.2 m height is immersed vertically in water with one of its diagonals horizontal and 1.5 m below the water level. Find the total pressure of one of its surfaces and the depth of centre of pressure.
b) A rectangular plane surface 2 m wide and 3 m deep lied in water in such a way that its plane is at an angle of 30^0 with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5 m below the water surface. 5+5

9. a) Water flows over a rectangular weir 1.5 m wide at a depth of 20 cm and afterwards passes through a triangular right-angled weir. Find the depth of water through the triangular weir. Discharge coefficients for the rectangular and triangular weirs are 0.62 and 0.59 respectively.
b) A 50 mm diameter orifice is discharging water under a head of 8 m. Calculate the actual discharge in lit/s and actual velocity of the jet is m/s at vena contracta. If $C_d = 0.6$ and $C_v = 0.9$. 5+5

10. a) Differentiate between pump and turbine.
b) Define Suction head, Delivery head, static head and manometric head of a centrifugal pump. 5+5