March 2021

HYDRAULICS (FOR CE)

Time Allowed: 3 Hours | Full Marks: 70

Answer to Question No.1 is compulsory and Answer any five questions from the rest.

1. Answer the following questions (any twenty): 1x20

Choose the correct answer from the givenalternatives:

i) Manometer is suitable for measuring – a) only low pressure, b) only high pressure, c) both high and low pressure, d) only negative pressure.

ii) Continuity equation deals with the law of conservation of – a) mass, b) energy, c) momentum, d) none of the above.

iii) The path followed by a fluid particle in motion is called a – a) stream line, b) streak line, c) path line, d) none of the above.

iv) Cippolett's weir is a trapezoidal weir having side slopes of – a) 1:4, b) 1:5, c) 2:3, d) 1:2.

v) For pipes connected in parallel – a) $h_f = h_{f1}+h_{f2}+.....$, b) $f=f_1+f_2+.....$, c) $v=v_1+v_2+.....$, d) $Q=Q_1+Q_2+.....$

vi) The discharge in an open channel corresponding to the critical depth is – a) Maximum, b) zero, c) Minimum, d) None.

vii) Sub critical flow is also called – a) Streaming Flow, b) Tranquil Flow, c) Shooting Flow, d) Both a & b.

viii) The depth after hydraulic jump is called – a) Initial depth, b) Sequent depth, c) Alternate depth, d) All of these.

ix) Loss of head at the entrance of a pipe – a) $v^2/2g$, b) $0.5\ v^2/2g$, c) $k\ v^2/2g$, d) None of these.

x) Priming is done in order to – a) run the pump satisfactorily, b) remove air from impeller and casing, c) completely fill the impeller and casing, d) all of the above.

xi) Ideal fluid is one which is – a) Compressible, possess viscosity & surface tension, b) Incompressible and has no viscosity & surface tension, c) Compressible and has no viscosity & surface tension, d) All of the above.

xii) Kinematic viscosity is defined as equal to – a) dynamic viscosity / density, b) pressure × density, c) dynamic viscosity × density, d) dynamic viscosity × pressure.

xiii) Which of the following is dimensionless? – a) Specific speed, b) Specific volume, c) Specific gravity, d) Specific weight.

Fill in the blanks:

xiv) Area velocity method is used for measurement of _____ of a river at a point.

xv) The flow in which fluid particles move in zigzag path is called _____ flow.

xvi) All pressure gauges when open to atmosphere gives reading _____.

xvii) A _____ is a short length of pipe fitted in a tank containing the fluid.

xviii) The point where total pressure acts is known as _____.

xix) _____ is that branch of hydraulics which deals with water at rest.

xx) The ratio of actual velocity of jet at vena-contracta to the theoretical velocity is called ___.

xxi) The reciprocal of mass density is known as _____.

xxii) The phenomenon of rise or fall of a liquid in a thin tube relative to the adjacent general level of liquid isknown as _____.

xxiii) Reciprocating pump is a type of _____ pump.

xxiv) Pelton wheel is a _____ of turbine.

xxv) In a most economical trapezoidal channel section,half of the top width = _____.

2. 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

3. 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

4. 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. https://www.wbscteonline.com 5+5

5. a) A flat plate of area 1.5 x 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

6. 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

7. 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

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

9. 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

10. 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
