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B.Tech
PCI3I101

3rd Semester Regular/Back Examination 2017-18
Fluid Mechanics & Hydraulics Machines
BRANCH: CIVIL
Time: 3 Hours
Max Marks: 100
Q.CODE: B1180

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1   **Answer the following questions:** *multiple type or dash fill up type*   **(2 x 10)**
- **a)** Surface tension of water increases with …….. in temperature.
- **b)** The expression for depth of centre of pressure for a vertically immersed plane and surface inclined at angle 'θ' with horizontal is ……….
- **c)** The Reynold's number for flow of oil in a certain pipe is 640. The Darcy-Weisbach factor, *f* for this flow will be …..
- **d)** The weight per unit volume of liquid at standard temperature and pressure is called ……….
- **e)** The length of a pipe is 1 km and its diameter is 20 cm. If the diameter of an equivalent pipe is 40 cm, then its length is ……
- **f)** Size of venturimeter is specified by ………….
- **g)** Equation of continuity is based on the principle of conservation of …….
- **h)** The specific speed of a turbine is expressed as …..
- **i)** A gradually expanding tube which discharges water passing through the runner to the tail race is ……
- **j)** Under ideal conditions the discharge in case of a double acting reciprocating pump is given by ……..

Q2   **Answer the following questions:** *Short answer type*   **(2 x 10)**
- **a)** If the kinematic viscosity of benzene is 7.42×10^{-3} stokes and its mass density is 860 kg/m^3, determine its dynamic viscosity.
- **b)** What are the limitations of Bernoulli's equation.
- **c)** Write any two characteristics of flow nets.
- **d)** A pipe of diameter 25 cm discharges 25 litres of water per minute. Find the velocity of water flowing through the pipe.
- **e)** What do you mean by *equivalent pipe*?
- **f)** Why an inverted U tube manometer is more sensitive than an upright manometer?
- **g)** Derive the force exerted by a jet on a curved vane moving in the direction of the jet.
- **h)** What limits the suction lift of a reciprocating pump?
- **i)** What is the major advantages of Kaplan turbine over other turbines?
- **j)** Why is *priming* necessary for centrifugal pumps?

Q3   **a)** A hydraulic ram 300 mm diameter and 1.5 m long moves within a concentric cylinder 300.4 mm diameter. The annular clearance is filled with oil of relative density 0.85 and kinematic viscosity 400 mm^2/s. What is the viscous force resisting the motion when the ram moves at a speed of 120 mm/s?   **(9)**

     b) A glass tube of 8 mm internal diameter is immersed in a liquid at 20^0 C. The specific weight of the liquid is 20601N/m^3. The contact angle is 60^0 and surface tension is 0.15 N/m. Calculate the capillary rise and also the radius of curvature of the meniscus.   **(6)**

Q4 **a)** A triangular gate of 2.0 m sides is placed at a vertical side of a tank where oil of specific gravity 0.80 is stored up to a height of 4.4 m above the base of the gate. Find the force exerted by the oil on the gate and its centre of pressure. The vertex of the triangular gate is located downward. **(8)**

b) Show that the metacentric height of a floating body is given by **(7)**
GM = I/V –BG
Where I = Moment of inertia of the plan of the floating body at the water surface, V = Volume of the body submerged in water, BG = Distance between the centre of gravity (G) and the centre of buoyancy (B)

Q5 **a)** A venturimeter is provided in a 200 mm diameter pipe for measurement of water discharge. For 100 KN/m^2 gauge pressure in the pipe, determine the diameter of throat of the venturimeter if it is to produce cavitation pressure there. The throat is 2.0 m higher than venture inlet. Take atmospheric pressure as 101.3 KN/m^2 and vapor pressure as 2.39 KN/m^2 absolute. The pipe carries a discharge of 62.8 l/s. **(7)**

b) A pipeline carrying water changes in diameter from 20 cm at section 1 to 40 cm diameter at section 2 which is 6 m at higher level. If the pressure at section 1 and 2 are 120 KN/m^2 and 80 KN/m^2, respectively and the discharge is 200 litres/s, determine the loss of head. **(8)**

Q6 **a)** The velocity components in a two dimensional flow are **(9)**
U= y^3 + 6x - 3x^2y   V= 3xy^2 - 6y - x
Check whether the flow satisfies continuity and irrotationality.

b) Distinguish among *stream line, path line and streak line*. **(6)**

Q7 **a)** A Francis turbine is required to give an output power of 15000 KW while working under a head of 140 m and speed of 300 rpm. Calculate the guide vane and runner angles and the leading dimensions of the runner. Assume overall efficiency 80%, hydraulic efficiency 88%, speed ratio 0.75, flow ratio 0.15, ratio of outer to inner diameter is 0.6, and percentage flow area blocked by runner vanes thickness is 4. **(10)**

b) Define specific speed of a turbine. Write the expression for it. **(5)**

Q8 **a)** A jet of water having a velocity of 36 m/s strikes a series of radial curved vanes mounted on a wheel which is rotating at 240 r.p.m. The jet makes an angle of 20^0 with the tangent to the wheel at inlet and leaves the wheel with a velocity of 6 m/s at an angle of 130^0 to the tangent to the wheel at outlet. Water is flowing from outward in a radial direction. The outer and inner radii of the wheel are 500 mm and 250 mm respectively. Determine
Vane angles at inlet and outlet
Work done per second per N of water, and
Efficiency of the wheel **(10)**

b) Draw and explain the indicator diagram for a reciprocating pump. **(5)**

Q9 **Write short notes of the followings :**
a) Fluid classification **(5)**
b) Stability of immersed and floating bodies **(5)**
c) Flow net **(5)**