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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^{2}y   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)**