B.Tech. Degree III Semester Examination in Marine Engineering December 2014

MRE 1305 FLUID MECHANICS AND MACHINERY

Time : 3 Hours   Maximum Marks : 100

(5 x 20 = 100)

I.   (a)   Discuss   (10)
            (i)   viscosity of fluid
            (ii)   surface tension
            (iii)   capillary rise
            (iv)   metacentric height
            (v)   pascal's law

    (b)   A manometer containing mercury is connected to two points 15 m apart, on a pipeline   (10)
carrying water. The pipeline is straight and slopes at an angle 15° with the horizontal.
The manometer gives a reading of 150 mm. Determine the pressure difference
between them.

OR

II.   (a)   State Buckingham's π theorem. What are repeating variables? How are repeating   (8)
variables selected in dimensional analysis?

    (b)   Show by dimensional analysis that for a completely submerged body, the drag force is   (12)
given by $F_d = \rho\, l^2 V^2 \varphi(\rho V l / \mu)$ where P-mass density of fluid, 1 – characteristic
length, V-velocity of flow, μ – viscosity of the fluid.

III.   (a)   Distinguish between the following.   (9)
            (i)   Steady flow and unsteady flow
            (ii)   Uniform flow and non uniform flow
            (iii)   Rotational and irrotational flow.

    (b)   A venturimeter of throat diameter 5 cm is fitted to a 12.5 cm diameter water pipeline.   (11)
The coefficient of discharge is 0.96. Calculate the flow in the pipeline when the
reading on a mercury – water differential u-tube manometer connected to the upstream
and throat section shows a reading of 20 cm.

OR

IV.   (a)   What are the minor energy losses of flow through pipes?   (5)

    (b)   Derive Chezy's formula to determine loss of head due to friction in pipes.   (7)

    (c)   The fluid velocity components are given by $u = x - 4y$ and $v = -y4x$. Show that   (8)
velocity potential exists and determine its form. Find also the stream function.

V. (a) Distinguish between forced vortex and free vortex. (8)

(b) A cylindrical vessel 12 cm in diameter and 30 cm deep is filled with water up to the (12) top. The vessel is open at the top. Find the quantity of liquid left in the vessel, when it is rotated about its vertical axis with a speed of 300 rpm and 600 rpm.

OR

VI. (a) Write notes on (i) Reynold's number (ii) resistance co-efficient. (8)

(b) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe (12) of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 lit/s. Find the pressure drop in the pipe and shear stress at pipe wall.

VII. (a) Obtain an expression for the work done per second of a curved plate by a jet of water (8) when the plate is moving in the direction of jet.

(b) A jet of water 50 mm diameter impinges on a curved vane and it is deflected through (12) an angle of 135°. The vane moves in the direction as that of jet with a velocity of 5m/s. If the rate of flow of water is 30 lit/s, neglecting friction determine

(i) Component of force on the vane in the direction of motion.
(ii) Power developed by the vane.
(iii) Efficiency.

OR

VIII. (a) Differentiate between (10)
(i) Impulse turbine and reaction turbine.
(ii) Radial flow and axial flow turbines.

(b) A pelton wheel has mean bucker speed of 10 m/s with a jet of water flowing at the rate (10) of 700 lit/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume a coefficient of velocity as 0.98.

IX. (a) Define a centrifugal pump. Explain the working of a single stage centrifugal pump. (8)

(b) A centrifugal pump with radial inflow delivers 0.08 m^3/s of water against a total head (12) of 40 m. The outer diameter of the impeller is 30 cm and its width at the outer periphery is 1.25 cm find the blade angle at outlet. The speed of the pump is 1500 rpm and its manometric efficiency is 80%.

OR

X. (a) Draw an indicator diagram for a reciprocating pump, considering the effect of (8) acceleration and friction in suction and delivery pipes. Find the expression for work done in case of single acting reciprocating pump.

(b) A single acting reciprocating pump has a plunger 10 cm diameter and a stroke length (12) of 200 mm. The centre of the pump is 4 m above the water level in the sump and 14 m below the level of water in a tank to which water is delivered by the pump. The diameter and length of suction pipe are 40mm and 6m while the delivery pipe are 30 mm and 18 m respectively, determine the maximum speed at which the pump may run without separation, if separation occurs at 7.85 N/cm^2 below atmospheric pressure. Take atmospheric pressure ahead = 10.3 m of water.

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