B.Tech. Degree III Semester Supplementary Examination in Marine Engineering December 2016

MRE 305 FLUID MECHANICS AND MACHINERY
(Prior to 2013 Scheme)

Time : 3 Hours　　　　　　　　　　　　　　　　　　　Maximum Marks : 100

$(5 \times 20 = 100)$

I.　(a)　Explain Newton's Law of Viscosity.　(4)

　　(b)　Explain the effect of temperature on viscosity of liquids and gases.　(5)

　　(c)　Explain different types of manometers.　(5)

　　(d)　Derive an expression for variation of pressure in static liquid.　(6)

OR

II.　(a)　Explain the stability of submerged and floating bodies.　(6)

　　(b)　Explain Rayleigh's method in dimensional analysis.　(6)

　　(c)　Using the method of dimensional analysis obtain an expression for discharge Q over a rectangular weir. The discharge depends on the head 'H' over the weir, acceleration due to gravity 'g', length of weir crest 'L', height of the weir crest over channel bottom 'z' and kinematic viscosity 'ν' of the liquid.　(8)

III.　(a)　Derive three-dimensional continuity equation in differential form.　(10)

　　(b)　Derive an expression for the discharge through a venturimeter.　(10)

OR

IV.　(a)　Derive an expression for power transmission through a pipe of length 'L' under a head of 'H'. Also determine the expression for efficiency of transmission.　(10)

　　(b)　In a pipe of 300 mm diameter and 800 m length an oil of specific gravity 0.8 is flowing at a rate of 0.45 m³/s. Find:　(10)

　　　　(i) Head loss due to friction
　　　　(ii) Power required to maintain the flow.

　　Take kinematic viscosity as 0.3 stoke.

V.　(a)　Derive an expression for Hagen Poiseuille's equation for a viscous fluid flow.　(10)

　　(b)　Crude oil of dynamic viscosity 1.5 poise and relative density 0.9, flows through a 20 mm diameter vertical pipe. The pressure gauges fixed 20 m apart read 600 kN/m² and 200 kN/m². Find the direction and rate of flow through pipe.　(10)

OR

VI.　(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 upto top. The vessel is open at top. Find the quantity of liquid left in the vessel when it is rotated about vertical axis with a speed of (i) 300 rpm and (ii) 600 rpm.　(12)

(P.T.O.)

VII. (a) Prove that for a curved radial vane the efficiency is given by (10)
$$\eta = \frac{2\left(V_{w1}U_1 \pm V_{w2}U_2\right)}{V_1^2}$$

(b) A jet of water 80 mm diameter and having a velocity of 20 m/s strikes at (10)
the centre of hemispherical vane. The linear velocity of vane is 10 m/s in
direction of jet. Find the force exerted on the vane. How would this force
change if jet strikes on a series of vanes attached to the circumference of
the wheel?

OR

VIII. (a) What are the classifications of hydraulic turbines? Explain. (10)

(b) A single jet pelton wheel runs at 300 rpm under a head of 510 m. The jet (10)
diameter is 200 mm, its deflection inside the bucket is 165° and its relative
velocity is reduced by 15% due to friction. Determine:
    (i) water power.
    (ii) resultant force on bucket.
    (iii) overall efficiency.

Take mechanical losses = 3%, coefficient of velocity = 0.98 and speed
ratio = 0.46.

IX. (a) Explain the working of a centrifugal pump with the help of a neat sketch. (10)

(b) A centrifugal pump impeller runs at 80 rpm and has outlet vane angle of (10)
60°. The velocity of flow is 2.5 m/s throughout and diameter of impeller at
exit is twice that at inlet. If manometric head is 20 m and manometric
efficiency is 75%, determine,

    (i) the diameter of impeller at exit.
    (ii) inlet vane angle.

OR

X. (a) Explain the main components and working of a reciprocating pump with (10)
the help of a neat sketch.

(b) A single acting reciprocating pump running at 50 rpm delivers 0.00736 (10)
m³/s of water. The diameter of piston is 200 mm and stroke length 300
mm. The suction and delivery heads are 3.5 m and 11.5 m respectively.
Determine:
    (i) theoretical discharge.
    (ii) coefficient of discharge.
    (iii) percentage of slip.
    (iv) power required to run the pump.

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