B.Tech Degree III Semester Examination in Marine Engineering December 2011

MRE 305 FLUID MECHANICS AND MACHINERY

Time : 3 Hours Maximum Marks : 100

I. (a) Discuss the following: (10)
- (i) Specific weight
- (ii) Specific gravity
- (iii) Surface tension
- (iv) Meta centre height
- (v) Pascal's Law

(b) Show that the center of pressure for a vertical semi circular plane submerged in a homogeneous liquid and with its diameter 'd' at the free surface lies on the center line at a depth of $3.\pi.d./32$ from the surface. (10)

OR

II. (a) Discuss the following: (9)
- (i) Reynolds Model Law
- (ii) Stability of submerged bodies
- (iii) Rayleigh's method

(b) Find the minimum apex angle of a solid cone of specific gravity 0.8 so that it can float in stable equilibrium in fresh water with its axis vertical and vertex downward. (11)

III. (a) Give examples for the following types of fluid flows: (10)
- (i) Steady uniform flow.
- (ii) Steady non-uniform flow.
- (iii) Unsteady uniform flow.
- (iv) Unsteady non-uniform flow.

(b) The velocity components in a two dimensional flow field for an incompressible fluid are given by (10)

$u = e^{x} Cos\, h(y)$ and $\vartheta = -e^{x} Sin\, h(x)$.

Determine the equation of streamline for this flow.

OR

IV. (a) Calculate the coefficient of discharge from a projecting mouthpiece in the side of a water tank assuming that the only loss is that due to the sudden enlargement of water stream in the mouthpiece. Take a coefficient of contraction 0.64. (8)

(b) A pipeline, 0.6m in diameter is 1.5km long. In order to augment the discharge, another parallel pipeline of the same diameter is introduced in the second half of the length. Neglecting minor losses, find the increase in discharge if $f = 0.04$. The head at inlet is 30m over that at the outlet. (12)

V. (a) What is the relationship between the average velocity and maximum velocity in the case of parallel flow between two fixed parallel plates? What do you understand by inlet region and developed region? (10)

(b) The Reynolds number for flow of oil through a 5cm diameter pipe is 1700. The kinematic viscosity, $v = 1.02 \times 10^{-6}\, m^2/s$. What is the velocity at a point 0.625cm. away from the wall. (10)

OR

VI. (a) Distinguish between: (8)
- (i) Cylindrical free vortex and a plane spiral free vortex flows.
- (ii) Cylindrical forced vortex and a spiral forced vortex flows.

(b) A closed cylinder 0.4m in diameter and 0.4m in height is filled with oil of special gravity 0.8. If the cylinder is rotated about its vertical axis at a speed of 200 rpm, calculate the thrust of oil on top and bottom covers of the cylinder. (12)

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VII. (a) Determine the force exerted by a jet on a moving curved vane, when the jet strikes the vane at its one end tangentially. Also, find an expression for efficiency of the system. (14)

(b) Distinguish between: (6)

(i) Tangential and radial flows.

(ii) Velocity of whirl and velocity of flow.

(iii) Impulse turbine and reaction turbine.

OR

VIII. (a) Explain the purpose of providing: (8)

(i) scroll casing

(ii) guide vanes, for a reaction turbine.

(b) In a projected low head hydroelectric scheme 283 m^3/s of water are available under a head of 3.66m. Alternative schemes to use Francis turbines having a specific speed of 400 or Kaplan turbine with a specific speed of 686 are investigated. The normal running speed is to be 50 rpm in both the schemes. Compare these two proposals in so far as the numbers of machines are concerned and estimate the power to be developed by each machine. The units in either installation are to be equal power and the efficiency of each type may be assumed to be 90%. (12)

IX. (a) What are the different efficiencies of a centrifugal pump? (6)

(b) A centrifugal pump impeller has an outer diameter of 300mm and an inner diameter of 150mm. The pump runs at 1200 rpm. The impeller vanes are set at a blade angle of 30° at the outlet. If the velocity of flow is constant at 2 m/s, calculate: (14)

(i) the velocity and direction of water at outlet.

(ii) the head developed if manometric efficiency is 85%.

(iii) the blade angle at inlet.

OR

X. (a) Give a sketch of the theoretical P-V diagram for the cylinder of a reciprocating pump, which is not fitted with air vessels. Show clearly the effect of acceleration and friction in both suction and delivery pipes. State the condition under which separation is likely to occur. (12)

(b) Working from the first principles show that the work saved against friction in the delivery pipe of a double acting reciprocating pump, by fitting an air vessel is 39.2%. (8)

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