B.Tech. Degree III Semester Examination in Marine Engineering December 2018

MRE 1305 FLUID MECHANICS AND MACHINERY

(2013 Scheme)

Time : 3 Hours   Maximum Marks : 100

$(5 \times 20 = 100)$

I.   (a)   Smoke issuing from a lighted cigarette-end rises up as a smooth streak to a   (6)
certain height, and then starts meandering. To which regimes of flow do these
two types of flow belong? Give another example of a similar transition.

     (b)   One can tell a raw egg from a boiled one by spinning it on a table. A boiled   (6)
egg spins for a longer time. Explain.

     (c)   A body of dimensions 1.5m × 1.0m × 2m, weighs 1960 N in water. Find its   (8)
weight in air. What will be its specific gravity?

OR

II.   (a)   What is the difference between U-tube differential manometer and inverted   (6)
U-tube differential manometer? Where are they used?

     (b)   An inverted U-tube manometer is connected to two horizontal pipes A and B   (6)
through which water is flowing. The vertical distance between the axes of
these pipes is 30 cm. When an oil of specific gravity 0.82 is used as a gauge
fluid, the vertical heights of water columns in the two limbs of the inverted
manometer (when measured for the respective centre lines of the pipes) are
found to be same and equal to 35 cm. Determine the difference of pressure
between the pipes.

     (c)   Write short notes on the following: (i) buoyancy (ii) metacenter (iii) dynamic   (8)
similarity

III.   (a)   Derive Euler's equation of motion.   (6)

     (b)   The water is flowing through a pipe having diameters 20 cm and 10 cm at   (6)
section 1 and 2 respectively. The rate of flow is 35 liters per second. The
section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure
at section 1 is 38 N/cm^2, find the intensity of pressure at section 2.

     (c)   The velocity vector in a fluid flow is given by   (8)
$V = 4x^3 yi - 10x^2 yj + 2tk$.
Find the velocity and acceleration of the fluid particle at (2, 1, 3) at time t = 2.

OR

IV.   (a)   What is the principle of pitot-static tube? Derive an expression for the velocity   (6)
of fluid flow.

     (b)   The velocity potential for a two dimensional flow is given by $\phi = x(2y-1)$.   (8)
Find the velocity at point P(3, 4). Also determine the value of stream function
at the point P.

     (c)   What do you understand by the terms (i) Total acceleration (ii) Convective   (6)
acceleration (iii) Local acceleration?

V.   Write short notes on the following:
           (i)   Steady and unsteady flow   (5)
           (ii)   Free vortex   (5)
           (iii) Dimensions of flow   (5)
           (iv) Reynolds number   (5)

OR

VI.	In a free cylindrical vortex flow, at a point in the fluid at a radius of 200 mm and at a height of 100 mm, the velocity and pressure are 10 m/s and 118 kN/m^2 absolute. Find the pressure at a radius of 400 mm and at height of 200 mm. The fluid is air having density equal to 1.24 kg/m^3.	(20)

VII.	A jet of water having a velocity of 15 m/s strikes a curved vane which is moving with a velocity of 5 m/s. The vane is symmetrical and is so shaped that the jet is deflected through 120°. Find the angle of the jet at inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per unit weight of water? Assume the vane to be smooth.	(20)

OR

VIII.	(a)	Define and explain hydraulic efficiency, mechanical efficiency and overall efficiency of a turbine.	(4)
	(b)	A Kaplan turbine working under a head of 29 m develops 1287.5 kW shaft power If the speed ratio is equal to 2.1, flow ratio = 0.62, diameter of boss = 0.34 times the diameter of the runner and overall efficiency of the turbine = 89%, find the diameter of the runner and the speed of turbine.	(8)
	(c)	The following data is related to the Pelton wheel:	(8)

Head at the base of the nozzle = 80 m

Diameter of the jet = 100 mm

Discharge of the nozzle = 0.30 m^3/s

Shaft power = 206 kW

Power absorbed in mechanical resistance = 4.5 kW

Determine: (i) Power lost in nozzle   (ii)   Power lost due to hydraulic resistance in the runner.

IX.	(a)	What is the difference between single-stage and multistage pumps? Describe multistage pump with (i) impellers in parallel (ii) impellers in series.	(6)
	(b)	Define cavitation. What are the effects of cavitation? Give necessary precautions against cavitation.	(6)
	(c)	The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and vanes are set back at an angle of 45° at outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 70%.	(8)

OR

X.	(a)	Define slip, percentage slip and negative slip of a reciprocating pump.	(5)
	(b)	What is an air vessel? Describe the function of the air vessel for reciprocating pumps.	(5)
	(c)	A double-acting reciprocating pump, running at 50 r.p.m is discharging 900 litres of water per minute. The pump has stroke of 400 mm. The diameter of piston is 250 mm. The delivery and suction heads are 25 m and 4 m respectively. Find the slip of the pump and power required to drive the pump.	(10)

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