Registration no: | | | | | | | | | | |

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PCI3I101

3RD Semester Regular Examination 2016-17
FLUID MECHANICS AND HYDRAULIC MACHINES
BRANCH: CIVIL
Time: 3 Hours
Max Marks: 100
Q.CODE: Y536

Answer Part-A which is compulsory and any four from Part-B.

The figures in the right hand margin indicate marks.

PART-A (ANSWER ALL THE QUESTIONS)

Q1 **Answer the following questions:** **(2 x 10)**

a) Fluids which do not follow the linear relationship between shear and rate of deformation are termed as…….fluids.

b) The manometers are suitable for comparatively …….pressures.

c) The intensity of pressure p is related to specific weight of the liquid and…….of the point by the equation.

d) An ice cube is floating in glass of water.as the cube melts the water level……..

e) A …… is an imaginary line within the flow so that the tangent at any point on it indicates the velocity at that point.

f) The coefficient of discharge of an orifice meter is …..that of a venturimeter.

g) In case of laminar flow, the loss of pressure head is ……

h) In an outward radial flow turbine energy conversion process is …….

i) …….. of a turbine is defined as the ratio of power available at the turbine shaft to the power supplied by the water jet.

j) A centrifugal pump should be so installed above water level in the sump such that the negative pressures are …….

Q2 **Answer all the following questions:** **(2 x 10)**

a) Define pressure. How pressure is measured?

b) A liquid has a sp.gravity of 1.9 and kinematic viscosity of 6 stokes. What is its dynamic viscosity?

c) The velocity distribution for flow over a plate is given by $u=2y-y^2$ where u is the velocity in m/s at a distance y meter above the plate.Determine the velocity gradient at boundary and 1.5m from it.

d) State the formula for total pressure and center of pressure for vertically immersed surface.

e) State Archimedes' principle.

f) State rotational and irrotational flow with an example.

g) State the different types of losses in pipe flow.

h) What do you mean by cavitation? State the effect of cavitation in turbine.

i) What do you mean by Characteristics of centrifugal pump?

j) Define Reynolds number. State the laminar and turbulent flow with respect to Reynolds number.

PART-B(ANSWER ANY FOUR QUESTIONS)

Q2

(a) Two large fixed parallel planes are 12mm apart. The space between the surfaces is filled with oil of viscosity 0.972 Ns/m^2. A flat thin plate $0.25m^2$ area moves through the oil at a velocity of 0.3 m/s. Calculate the drag force **(1)** when the plate is equidistant from both the planes. **(2)**When the thin plate is at a distance 4mm from one of the plane surfaces. **(5)**

(b) State and prove Hydrostatic law. **(4+6)**
A U-tube manometer is used to measure the pressure of oil of sp.gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and right limb is open to the atmosphere. The center of pipe is 100mm below the level of mercury (sp.gravity=13.6) in the right limb. If the difference of mercury level in the two limb is 160mm, determine the absolute pressure of oil in the pipe.

Q3

a) A cubical tank has sides of 1.5m.It contains water for the lower 0.6m depth. The upper remaining part is filled with oil of sp.gravity 0.9.Calculate for one vertical side of the tank **(1)**total pressure and **(2)**Position of center of pressure. **(5)**

b) Explain with a neat sketch all the conditions of equilibrium of a floating body. **(4+6)**
A solid of 200mm diameter and 800mm length has its base 20mm thick and of sp.gravity 6.The remaining part of the cylinder is of sp.gravity 0.6.State if it can float vertically in water.

Q4

a) The velocity components for a fluid flow are given by u=a+by-cz, v=d-bx-ez, w=f+cx-ey, where a,b,c,d,e and f are arbitrary constants. **(1)**Show that it is a possible case of fluid flow.**(2)** Is the fluid flow is irrotational? **(5)**

b) State the assumptions of Bernoulli's theorem. **(2+8)**
Determine the rate of flow of water through a pipe of 300mm diameter placed in an inclined position where a venturimeter is inserted having a throat diameter of 150mm.The difference of pressure between the main and throat is measured by a liquid of sp.gravity 0.7 in an inverted U-tube which gives a reading of 260mm.The loss of head between the main and throat is 0.3 times the kinetic head of pipe. Assume any data if not given.

Q5

a) An orifice meter with diameter 15cm is inserted in a pipe of 30cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50cm of Hg. Find the rate of flow of oil of sp.gravity 0.9 when the coefficient of discharge of meter is 0.64. **(5)**

b) A horizontal pipe line 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300mm.The height of water level in the tank is 8m above the center of the pipe. Considering all loses of head which occurs, determine the rate of flow. f=0.01 for both section of pipe. **(10)**

Q6

a) Derive the Euler's equation in integral form and mention the assumptions. **(5)**

b) A syphon of diameter 200m connects two reservoirs having a difference in elevation of 15m. The total length of the syphon is 600m and the summit is 4m above the water level in upper reservoir. If the separation takes place at 2.8m of water absolute, find the maximum length of the syphon from upper reservoir to summit. **(10)**
Take f=0.004 and Atmospheric pressure= 10.3m of water

Q7 **a)** Explain NPSH. **(2+8)**
The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 rpm are 200mm and 400mm respectively. The discharge through pump is $0.04m^3/s$ and velocity of flow is constant and equal to 2.0m/s. The diameter of suction and delivery pipe are 150mm and 100mm respectively and suction and delivery heads are 6m(abs) and 30m(abs) of water respectively. If the outlet vane angle is 45 degree and power required to drive the pump is 16.186KW.Determine **(1)** vane angle of impeller at inlet.**(2)**The overall efficiency of pump.**(3)** Manometric efficiency of the pump.

b) With a neat sketch explain the Working principle of a reciprocating pump. **(5)**

8 **a)** Define specific speed of a turbine. With a neat sketch describe the different types of characteristic's curves of a hydraulic turbine. **(5)**

b) An inward flow reaction turbine running at a rotational speed of 400 rpm requires a discharge of $15m^3/s$ has an overall efficiency of 90%. The velocity at the inlet of the spiral casing is 8.5m/s and pressure head of 230m. The centre-line of the spiral casing inlet is 2.5m above the tail water level. The diameter of the runner at the inlet is 2m and width at the inlet is 0.25m. if the hydraulic efficiency is 95 % and the flow is radial at the outlet from the runner, calculate **i)** the power developedby the turbine**ii)** specific speed **(10)**
iii)guide vane angle **iv)** runner blade angle at inlet **v)** percentage of net head which is kinetic at entry to the runner.
Assume the blade thickness as negligible.

9 **a)** Three–jet pelton turbine is required to generate 16000 Kw under a net head of 400m.The blade angle at outlet is 15 degree and the reduction in the relative velocity while passing over the blade is 5%.If the overall efficiency is 80% Cv=0.98 and speed ratio is 0.46, then find (1) the diameter of jet, (2) total flow in m^3/s (3)Force exerted by a jet on the buckets. If the jet ratio is not to be less than 10,find the speed of the wheel for a frequency of 50Hz/s and the corresponding wheel diameter. **(10)**

b) Differentiate between Impulse turbine and reaction turbine. **(5)**