Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.TECH**

PME4G001

4th Semester Minor Examination 2016-17
FLUID MECHANICS & HYDRAILIC MACHINES

BRANCH: MECH

Time: 3 Hours

Max Marks: 100

Q.CODE:Z1118

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:*multiple type or dash fill up type*** **(2 x 10)**

a) Show that the coefficient of thermal expansion for perfect gas is equal to the absolute temperature.

b) If the temperature dependence of the shear viscosity of a liquid is modelled by the law: $\mu = Ae^{B/T}$, then calculate the temperature at which the shear viscosity of water is equal to 40% of its value at 20OC, given that μ (20^{O}C)=0.001 Ns/m^2 and μ (0^{O}C)=0.0018 Ns/m^2.

c) Provide two engineering applications in which body force other than gravity are important.

d) ρ =constant implies that $\frac{D\rho}{Dt}=0$, but is ture that $\frac{D\rho}{Dt}=0$, implies ρ is constant. Explain it.

e) Define Pascal's Law of hydrostatic.

f) Show with appropriate diagrams than stability of a submerged body.

g) Differentiate uniform and non-uniform flows.

h) Write the equation for pure rotation of a fluid element.

i) Define a streak line

j) Write the assumptions for Newton's Law of viscosity.

Q2 **Answer the following questions: *Short answer type*** **(2 x 10)**

a) The velocity and density fields in a diffuser are given by: $u = u_0 e^{-x/L}$ and $\rho = \rho_0 e^{-2x/L}$. Find the rate of change of density at x=L.

b) A block of steel (sp. gr.= 6.85) floats at a mercury-water interface. What is the ratio of heights of the bock in mercury (b) and in water (a). Take specific gravity of mercury as 13.57.

c) The velocity field of a fluid particle is given by $\vec{V} = 10x^2 y\hat{i} + 15xy\hat{j} + (25t - 3xy)\hat{k}$. Find the acceleration of the fluid particle at (1,2,-1) at time t=0.5.

d) Determine the loss of head in friction when water at 15 OC flows through a 300 m long galvanized steel pipe of 150 mm diameter at 0.05 m3/s. Kinematic viscosity of water at 15 ^{O}C is 1.14×10^{-6} m2/s and friction factor (f) is 0.001. Also calculate the pumping power required to maintain the flow.

e) Write the assumptions of the Bernoulli's equation.
f) Write the formula for the speed number of a turbine.
g) Write three different parts that are susceptible to erosions in Francis turbines.
h) Draw the variations of unit discharge and unit power with unit speed for Kaplan turbine.
i) Define slip factor in centrifugal pumps.
j) What is function of volute casing in reaction turbines?

Part – B (Answer any four questions)

Q3 **a)** A spherical soap bubble of diameter d1 coalescences with another bubble of diameter d_2 to form a single bubble of diameter d_3 containing the same amount of air. Assuming an isothermal process, derive an analytical expression for d3 as a function of d_1, d_2, the ambient atmospheric pressure P_0 and surface tension of the soap bubble is τ. **(10)**

b) Find the circulation for the velocity filed given as $u(y)=\left[\frac{h^2(p_1-p_2)}{2\mu L}\right]\left[1-\frac{y^2}{h^2}\right]$, $v=w=0$ along a rectangular path of height h and width L. **(5)**

Q4 **a)** Water flows through a 300 mm×150 mm venturimeter at a rate of 0.037 m^3/s and the differential gauge is deflected 1m. Specific gravity of the gauge fluid is 1.25. Determine the coefficient of discharge for the venturimeter. Take density of water 1000 kg/m^3 **(10)**

b) For the flow with a stream function $\psi=\ln(x^2+y^2)$, determine the velocity components and check for irrationality. **(5)**

Q5 **a)** Oil of Specific gravity of 0.8 cats on vertical triangular area whose apex is in the oil surface. The triangle is isosceles of 3 m high and 4 m wide. A vertical rectangular area of 2 m high is attached to 4 m base of the triangle and is acted upon by water. Find magnitude and position of action of resultant hydrostatic force on the entire area. **(10)**

b) Derive equation from Euler's equation along a streamline. **(5)**

Q6 **a)** Two reservoirs 5.2 km apart are connected by a pipeline which consists of a 225 mm diameter pipe for first 1.6 km, slopping at 5.7 m per km. For the remaining distance, the pipe diameter is 150 mm laid at slope of 1.9 m per km. The level of water above the pipe openings are 6 m in the upper reservoir and 3.7 m in the lower reservoir. Taking f=0.024 for both the pipes and C_c =0.6, Calculate the rate of discharge through the pipe. **(10)**

b) Show that head loss per unit weight due to friction is given by $h_f=\frac{fLV^2}{2gD}$. **(5)**

Q7 **a)** A Pelton wheel turbine has a net head of 425 m. Assuming C_v=0.97, speed ratio=0.46, jet deflection angle at bucket 165 degrees and bucket friction coefficient as 0.9, Calculate the hydraulic, wheel and nozzle efficiencies of the turbine **(10)**

b) Explain the governing of the Pelton turbine. **(5)**

Q8 **a)** A horizontal double-acting single cylinder reciprocating pump has following features: **(10)**

Cylinder diameter= 20 cm; Speed= 30 rpm; Length of suction pipe =4 m; Delivery lift= 30 m; Diameter of delivery pipe= 10 cm; Length of stroke=40 cm; Suction lift= 1.5 m; Diameter of suction pipe= 10 cm; length of delivery pipe= 40 m; Dracy-Weisbach friction factor =0.2 for both the pipes. Determine the net force due to water pressure on the piston when the crank has moved by an angle of 45-degree from inner dead canter. The size of the piston rod can be neglected as relatively too small.

b) Draw the indicator diagram for a reciprocation pump considering both acceleration and friction effects. Write the formula for the frictional head loss in suction pipe and its maximum value. Also write the formula for average frictional loss in the suction pipe. **(5)**

Q9 **a)** A centrifugal pump lifts water from a sump to an overhead reservoir. The static lift is 40 m out of which 3 m is suction lift. The suction and delivery pipes are both 35 cm diameter. The friction loess in the suction pipe is 2.0 m and delivery pipe it is 6.0 m. The impeller is 0.5 m in diameter and has a width of 3 cm at outlet. The speed of the pump is 1200 rpm. The exit blade angle is 20-degree. If the monomeric efficiency is 85%, determine the pressure at the suction and delivery ends of the pump and the discharge. Assume the inlet and outlets of the pump are at same elevation. **(10)**

b) Write short notes on hydraulic press. **(5)**

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PCME4201

3rd Semester Back Examination 2016-17
FLUID MECHANICS AND HYDRAULIC MACHINES
BRANCH(S): AERO, CIVIL, MECH, MINERAL, MINING

Time: 3 Hours

Max Marks: 70

Q.CODE: Y638

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

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

a) A hydraulic press has a ram of 30cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500N.

b) Differentiate between kinematic viscosity and dynamic viscosity.

c) Name the different types of forces present in fluid flow.

d) Derive the force exerted by a jet on a curved vane moving in the direction of the jet.

e) Why priming is necessary for centrifugal pump.

f) Determine the density, specific weight and specific volume of ait if the specific gravity (water as reference fluid) is 0.011614.

g) What is hydrostatic pressure distribution? Give one example where pressure distribution is no hydrostatic.

h) A fluid flow is given by $V_r=(1-a/r^2)\cos\theta$, $V\theta= -(1+a/r^2)\sin\theta$. Determine whether the flow is rotational or irrotational.

i) What is draft tube? Why it is used in reaction turbine.

j) What do you mean by cavitation? How to avoid cavitation in turbine.

Q2 **(a)** With a diagrammatical representation describe the different types of fluids with an example. **(5)**

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

Q3 **a)** A body has the cylindrical upper portion of 3m diameter and 1.8m deep. The lower portion o is a curved one, which displaces a volume of 0.6m^3 of water. The center of buoyancy of the curved portion is at a distance of 1.95m below the top of the cylinder. The center of gravity of the whole body is 1.20m below the top of the cylinder. The total displacement of water is 3.9 tonnes. Find the metacentric height of the body. **(5)**

b) In a 2D incompressible flow ,the fluid velocity components are given by u=x-4y, and v= -y-4x.Show that velocity potential exists and determine its form as well as stream function. **(5)**

Q4 **a)** A 30cmx15cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30cm.The differential u tube mercury manometers shows a gauge deflection of 25cm.calculate(1) the discharge of oil(2) the pressure difference between entrance and throat section .Take Cd as 0.98 and specific gravity of mercury as 13.6. **(5)**

b) Find the acceleration and vorticity components at a point (1,1,1) for the following flow field: $u=2x^2+3y$, $v= -2xy+3y^2+3zy$, $w= -3/2\ z^2+2xz-9y^2z$. **(5)**

Q5 **a)** Define specific speed of a turbine and derive an expression for the same. State its significance. **(5)**

b) The water available for a pelton wheel is 4cumec and the total head from the reservoir to the nozzle is 250m.The turbine has two runners with two jets per runner .All the four jets has the same diameters. The pipe line is 3000m long. The efficiency of power transmission through the pipe line and the nozzle is 91% and efficiency of each runner is 90%.The velocity of each nozzle is 0.975 and coefficient of friction '4f' for the pipe is 0.0045.Determine (1) The power developed by the turbine (2) the diameter of the jet (3) The diameter of the pipe. **(5)**

Q6 **a)** What do you mean by Indicator diagram? With a neat sketch explain ideal indicator diagram for reciprocating pump. **(5)**

b) The impeller of a centrifugal pump having external and internal diameters 500mmmm and 250mm, width at outlet 50mm and running at 1200 rpm works against a head of 48m.The velocity of flow through the impeller is constant and equal to 3.0m/s. The vanes are set at an angle of 40^0 at outlet. Determine (1) inlet vane angle.(2) work done by the impeller on water per sec. (3) manometeric efficiency. **(5)**

Q7 Derive Euler's equation of motion along a stream line for an ideal fluid stating clearly the assumptions. Explain how Bernoulli's equation is derived from Euler's equation. **(10)**

Q8 **Write short notes on any two:** **(5 x 2)**

a) Difference between impulse and reaction turbine.

b) Differential manometer.

c) Multistaging of centrifugal pump.

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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)**