Code No: R1621034 **R16** SET - 1

II B. Tech I Semester Regular Examinations, October/November - 2017
FLUID MECHANICS & HYDRAULIC MACHINES
(Com to ME & Mining Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) How does the dynamic viscosity of liquid and gases vary with temperature? 2M
b) What is minor loss in pipe flow? 2M
c) Define boundary layer separation. 2M
d) Find the force exerted by a jet of water of diameter 70mm on a stationary flat plate, normally with a velocity of 25m/s. 2M
e) Define the terms, Slip and Negative slip in reciprocating pumps 3M
f) Draw inlet and outlet velocity triangles for a Pelton wheel. 3M

PART –B

2. a) Write briefly about different types of Pressure measuring devices 7M
b) A fan delivers 4 m^3 of air per second at 20^0C and 1.25 bar. Assuming molecular weight of air as 28.97, calculate the mass of air delivered .Also determine the density, specific volume and specific weight of the air being delivered. 7M

3. a) Check whether the following velocity relations satisfy the requirements for steady irrotational flow. 7M
(i) $u = x + y$, $v = x – y$ (ii) $u = xt^2 + 2y$, $v = x^2 – yt^2$ (iii) $u = xt^2$, $v = xyt + y^2$
b) Derive friction factor for the flow through the circular pipe by Darcy Weisbach equation? 7M

4. a) A thin plate is moving in still atmospheric air at a velocity of 5m/sec. The length of the plate is 0.6m and width 0.5m. Calculate the thickness of boundary layer at the end of the plate. Take density of air as 1.25 kg/m^3 and kinematic viscosity is 0.15 stokes. 7M
b) Define & explain i) Froude's number ii) Mach number iii) Model similarities. 7M

5. a) Show that force exerted by a jet of water on a inclined fixed plate in the direction of the jet given by: 6M
$F_x = \rho A V^2 \sin\alpha$
Where V is the velocity of the jet; A is the area of the jet; α is the inclination of plate to the direction of the jet.
b) A 7.5 cm diameter of jet having a velocity of 30m/s strikes a flat plate, the normal of which is inclined at 45^0 to the axis of the jet. Find normal pressure on the plate, when (i) the plate is stationary and (ii) when the plate is moving with a velocity of 15m/s. determine the power and efficiency of the jet when plate is moving. 8M
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6.	a)	Explain the multistage pumps with impellers in series and parallel.	7M
	b)	A centrifugal pump is to discharge $0.118m^3$/ sec at a speed of 1450 rpm against a head of 25m. The impeller diameter at outlet is 250mm and its width at outlet is 50mm and manometric efficiency is 75%. Determine vane angle at outer periphery of the impeller	7M
7.	a)	Differentiate between i) Impulse and Reaction turbine ii) Radial and Axial flow Turbines iii) Inward and Outward Radial flow turbines	6M
	b)	Explain with the help of neat sketch, the working of the hydraulic coupling.	8M

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PART –A

1. a) Define metacentric height. 2M
b) Explain hydraulic gradient line for fluid flow through a piping system. 2M
c) What is meant by Dynamic similarities? 2M
d) Define the term impact of jet. 2M
e) Why pumps are generally less efficient than turbines. 3M
f) What are the advantages of amplifiers and sensors in fluidics? 3M

PART –B

2. a) Define the terms: (i) absolute pressure (ii) Gauge Pressure (iii) vacuum pressure 6M
b) A triangular plate of base width 1.5 m and height 2 m lies immersed in water with the apex downwards. The base of the plate is 1 m below and parallel to the free water surface. Calculate the total pressure on the plate and the depth of the centre of pressure. 8M

3. a) Two pipes one of 10cm diameter, 200 m long and another 15cm diameter, 400 m long are connected in parallel. The friction factors are 0.0075 for the smaller pipe and 0.006 for the large pipe. The total discharge through the system is 50 lit/sec. Find the discharge and head loss in each pipe. Neglect minor losses. Calculate the equivalent length of a 20 cm diameter having f=0.005 9M
b) State the momentum equation and mention some of its engineering applications. 5M

4. a) State Buckingham's π-theorem. What is the advantage of Buckingham's π-theorem over Rayleigh's method of dimensional analysis 7M
b) The velocity profile for laminar boundary layer flow is given as $u/U = (y/\delta)^{0.22}$. Find displacement thickness, momentum thickness and energy thickness. 7M

5. a) An experiment was conducted in Hydraulic Machinery Laboratory and the following values were observed. 9M
Diameter of Pipe is 40 cm
Diameter of Jet is 7.5 cm
Velocity of Jet is 20 m/sec.
Conditions: (i) Plate is at rest. (ii) Plate is moving in the same direction of flow with velocity 5m/sec. Based on the observations find out the thrust and work done/sec for condition (i) & (ii) And also calculate the efficiency of the jet for condition (ii)
b) Find an expression for Force exerted by a fluid jet on stationary flat plate. 5M
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Code No: R1621034 **R16** SET - 2

6.	a)	List out necessary precautions against cavitation in centrifugal pumps.	7M
	b)	Explain the working of reciprocating pump with neat sketch.	7M
7.	a)	A Kaplan turbine works under a head of 60m at a speed of 145rpm utilizing $175m^3/s$ of water. Diameter of runner and hub are 5.60m & 3.20m. Turbine develops 82500 kW. Find i) flow ratio ii) speed ratio iii) overall efficiency iv) specific speed.	7M
	b)	Explain what is meant by unit quantities in turbines. Derive expressions for unit speed, unit discharge and unit power of a turbine.	7M

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PART –A

1.	a)	Define Kinematic Viscosity and mention its significance	2M
	b)	What is the difference between laminar flow and turbulent flow?	2M
	c)	What is meant by boundary layer theory.	3M
	d)	A jet of water 5cm in diameter, issues with a velocity of 20 m/sec and impinges on a stationary flat plate which destroys the forward motion. Find the force exerted by the jet.	3M
	e)	Define NPSH.	2M
	f)	List out various classification of turbines.	2M

PART -B

2.	a)	A cylindrical buoy , 1.6 m in diameter x 1.3 m in length and weighing 5 kN floats in sea water with its axis vertical , A 500 N load is placed centrally at the top of the buoy. If the buoy is to remain in stable equilibrium, find the maximum permissible height of the centre of gravity of the load above the top of the buoy. Specific weight of sea water =10 kN/m^3	8M
	b)	The pressure outside the droplet of water of dia 0.04 mm is 10.32 N/cm^2 .calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water	6M
3.	a)	Derive the Bernoulli's equation from the Euler's equation.	8M
	b)	A 60 cm diameter pipeline carries oil (specific gravity= 0.85) at 82500 m^3 per day. The friction head loss is 8.5 m per 1000m of pipe run. It is planned to place pumping stations every 20 km along the pipe. Make calculations for the pressure drop in kN/m^2 between pumping stations.	6M
4.	a)	Explain the effect of pressure gradient on separation of boundary layer.	8M
	b)	What is meant by geometric, kinematic and dynamic similarities? Are these similarities truly attained? If not why?	6M
5.	a)	A jet of water of diameter 100 mm strikes a curved plate at its centre with a velocity of 15 m/sec. The curved plate is moving with a velocity of 7 m/sec in the direction of the jet. The jet is deflected through an angle of 150^0. Assuming the plate is smooth find (i) force exerted on the plate in the direction of the jet (ii) power of the jet (iii) efficiency	7M
	b)	Derive an expression for force exerted by the jet of water on moving curved plate?	7M
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6. a) Draw and discuss characteristic curves of a pump. 7M

   b) A double acting reciprocating pump having piston area 0.1m has a stroke of 0.30m long. The pump is discharging 2.4 m^3 of water per minute at 45 rpm through a height of 10 m. Find the slip of the pump and power required to drive the pump. 7M

7. a) What is the importance of a draft tube in a Francis turbine? Discuss different types of draft tubes. 7M

   b) A turbine is to operate under a head of 25 meters at 200 rpm. The discharge is 9 m^3/sec. If the turbine efficiency is 90% determine: (i) specific speed of the turbine (ii) power generated (iii) performance under a head of 20 meters. Also state the type of the turbine. 7M

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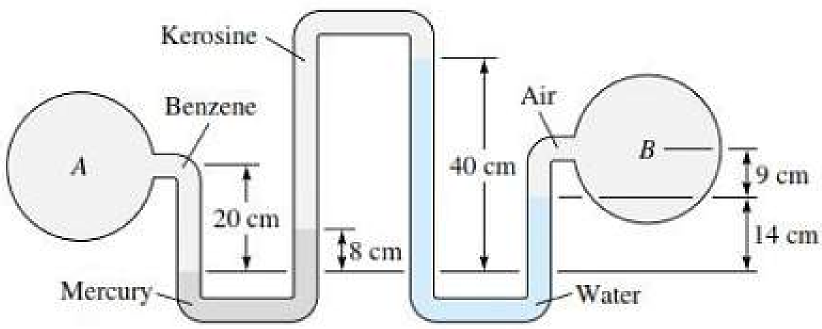
PART –A

1. a) Define total pressure and centre of pressure. 2M
b) Mention the applications of Impulse- Momentum equation 2M
c) Name some dimensionless numbers. 2M
d) Write down an expression for the normal force exerted by liquid jet on a fixed plate when the plate is inclined position. 3M
e) Define specific speed of a pump 2M
f) What is surge tank? What are the purposes served by it 3M

PART -B

2. a) In the Fig. below all fluids are at 20°C. Determine the pressure difference (Pa) between points A and B. Take the specific weights to be Benzene:8640 N/m^3,Mercury: 133100 N/m^3,Kerosene: 7885 N/m^3,Water: 9790 N/m^3 8M



b) Explain Buoyancy, Buoyancy Force and Centre of Buoyancy 6M

3. a) Water under a pressure of $3.924 \times 10^{-3} N/m^2$ is flowing through a 0.3 m pipe at the rate of 0.25 m^3/sec. if the pipe is bent 135^0, find the magnitude and direction of the resultant force on the bend. 8M
b) Define path line, streak line and the stream line. For what type of flow these lines are identical. 6M

4. a) A 2.5 m ship model was tested in fresh water (ρ= 1000 kg/m^3) and measurements are indicated that there was a resistance of 45N when the model was moved at 2 m/sec. Work out the velocity of 40 m prototype. Also calculate the force required to drive the prototype at this speed through sea water (ρ= 1000 kg/m^3). 7M
b) What are the different methods of preventing separation of boundary layers? Explain in detail. 7M
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5.	a)	Explain the concepts of velocity triangles by considering a jet striking an unsymmetrical moving curved vane tangentially at one of the tips.	8M
	b)	A 150mm diameter jet moving at 30m/s impinges on a curved vane moving at 15m/s in the direction of the jet. The jet leaves the vanes at 60^0 with the direction of motion of the vanes. Calculate: (i) Force exerted by the jet in the direction of motion of vanes (ii)Work done by the jet per second	6M
6.	a)	A single – acting reciprocating pump running at 50rpm, delivers $0.01m^3/s$ of water. The diameter of the piston is 200mm and stroke length 400mm. determine the theoretical discharge of the pump and co-efficient of discharge, and slip and the percentage slip of the pump.	8M
	b)	Differentiate between reciprocating pump and centrifugal pump.	6M
7.	a)	What is a draft-tube? Why is it used in a reaction turbine? Describe with neat sketch two different types of draft tubes.	8M
	b)	Illustrate hydraulic intensifier with a neat sketch.	6M