Code No: R21021 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, June - 2015
FLUID MECHANICS AND HYDRALICS MACHINES
(Com. to EEE, ME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1 a) What is viscosity? Why it is important in fluid mechanics? Define Kinematic and dynamic viscosity. [8]

b) A plate (2m x 2m), 0.25 mm distant apart from a fixed plate, moves at 40 cm/s and requires a force of 1 N. Determine the dynamic viscosity of the fluid in between the plates. [7]

2 a) Distinguish between (i) steady and unsteady flow (ii) uniform and non-uniform flow (iii) irrotational and rotational flow. [8]

b) Calculate the velocity components *u* and *v* for the following (i) $\phi = x + y$ (ii) $\phi = x^2 + y^2$ [7]

3 a) Derive an expression for the loss of head due to friction in flow through circular pipes. [8]

b) A venture meter has its axis vertical, the inlet and throat diameters being 150mm and 80 mm respectively. The throat has 220mm about inlet and coefficient discharge is 0.96. Petrol of specific gravity 0.78 flows up through the meter at a rate of 0.029 m^3/s. Find the pressure difference between the inlet and the throat. [7]

4 A jet with a velocity V strikes normally on a series of at plates moving with a velocity KV and mounted radially on the periphery of a wheel. Prove that the efficiency of the plate is given by $\eta = 2K(1 - K)$. [15]

5 a) Define (i) Firm and secondary power (ii) Load factor, utilization factor and capacity factor. {7}

b) Discuss in detail the different components of hydroelectric power plants. [8]

6 A Pelton wheel operates with a jet of 150mm diameter under the head of 500m. Its mean runner diameter is 2.25 m and it rotates with speed of 375 rpm. The angle of bucket tip at outlet as15^0 coefficient of velocity is 0.98, mechanical losses equal to 3% of power supplied and the reduction in relative velocity of water while passing through bucket is 15%. Find (a) the force of jet on the bucket, (b) the power developed (c) bucket efficiency and (d) the overall efficiency. 15
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7	a)	Define specific speed of a turbine. Derive the expression for the specific speed of turbine.	7
	b)	Briefly explain about the water hammer in pipes. Discuss the water hammer in penstock.	8
8	a)	How will you obtain an expression for the minimum speed for starting a centrifugal pump?	7
	b)	The diameter of an impeller of a centrifugal pump at inlet and outlet are 300mm and 600 mm respectively. The velocity of ow at outlet is 2.5 m/s and vanes are set back at an angle of 45o at outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 75 %.	8

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1	a)	Define surface tension. Discuss how some insects walk on the surface of the fluid.	[8]
	b)	Air is introduced through a nozzle into a tank of water to form a stream of bubbles. If the bubbles are intended to have a diameter of 2 mm, calculate how much the pressure of the air at the tip of the nozzle must exceed that of the surrounding water. Assume that the value of surface tension between air and water as 72.7 x 10-3 N/m.	[7]
2	a)	Write a short note on, Uniform and non uniform flow with suitable example	[7]
	b)	Calculate the unknown velocity components so that they satisfy continuity equation. (i) $u = 2x^2$; $v = xyz$; $w = ?$	[8]
3	a)	Write a short note on Flow Nozzle, Turbine flow meter, Darcy Weisbach Equation	[7]
	b)	A 150mm X 75mm venture meter with a coefficient of discharge o 0.98 is to be replaced by an orifice meter having a coefficient of discharge o 0.60.If the both the meters are to give the same differential mercury manometer reading for a discharge of 100 liters per second and the inlet diameter is to remain 150mm. what should be diameter of the orifice.	[8]
4	a)	Derive the expression for the force exerted by a jet of water on inclined fixed plate in the direction of jet.	[7]
	b)	A jet of water strikes with a velocity of 35m/s a at plate inclined at 300 with the axis of the jet. If the cross-sectional area of the jet is 25cm^2 determine. (i). The force exerted by the jet on the plane (ii). The components of the force in the direction normal to the jet. (iii). The ratio in which the discharge gets divided after striking the plate.	[8]
5	a)	Discuss in detail about flow duration curve and mass curve.	[7]
	b)	Discuss the hydroelectric power development in India. Write about any one major hydroelectric power station in Andhra Pradesh.	[8]
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6 a) Differentiate between Impulse turbine and Reaction turbine. [7]

b) A Powerhouse is equipped with impulse turbines of Pelton type. Each turbine delivers a power of 14 MW when working under a head 900 m and running at 600 rpm. Find the diameter of the jet and mean diameter of the wheel. Assume that the overall efficiency is 89%, velocity coefficient of jet 0.98, and speed ratio 0.46. [8]

7 a) By means of a neat sketch explain the governing mechanism of Francis turbine. [6]

b) A water turbine delivering 10MW power is to be tested with the help of a geometrically similar 1:8 model which runs at the same speed as the prototype. [9]
(i) Find the power developed by the model assuming the efficiency of the model and the prototype are equal .
(ii) Find the ratio of the heads and the ratio of mass flow rates between the prototype and the model.

8 a) How is the selection of pumps made? Give the operational difficulties commonly experienced in centrifugal pumps and their remedies. [7]

b) A single acting reciprocating pump running at 30rpm delivers 0.02 m^3/s of water. The diameter of the piston is 250mm and stroke length 500mm determine: [8]
(i). The theoretical discharge of the pump.
(ii). Co-efficient of discharge.

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1 a) Define Specific weight, mass density, vapour pressure and bulk modulus with appropriate dimensions and units. [8]

b) A tape of 0.015 cm thick and 1.00 cm wide is to be drawn through a gap with a clearance of 0.01cm on each side. A lubricant of dynamic viscosity 0.021 Ns/m 2 completely fills the gap for a length of 80 cm along the tape. If the tape can withstand a maximum tensile force of 7.5 N calculate the maximum speed with which it can be drawn through the gap. [7]

2 a) Derive Bernoulli`s equation from Euler`s equation of motion. [8]

b) A pipe through which water is flowing, is having diameters, 20cm and 10cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given as 4 m/s. Find the velocity head a sections 1 and 2 and also rate of discharge. [7]

3 a) What are the different losses in flow through the circular pipes. [7]

b) A pipe is 50mm diameter is 6m long and the velocity of flow of water in the pipe is 2.5m/s. what loss of head and corresponding power would be saved if the central 2m length of the pipe is replaced by 75mm diameter pipe, the change of section being sudden. Assume $f = 0.04$ for both the pipe. [8]

4 a) Find an expression for the force exerted by a jet on stationary curved plate, when the jet strikes the curved plate at the center. [6]

b) A jet of water of diameter 5 cm moving with a velocity of 40 m/s strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet, if the jet is detected through an angle of 120^0 at the outlet of the curved plate. [9]

5 a) What are the different components of hydro power plant? what are the purposes of providing them. [7]

b) What is meant by mass curve and explain in detail the construction of mass curve [8]
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6 a) Discuss the classification of Hydraulic turbines. [8]

b) A Francis turbine has a wheel diameter of 1.2 m at the entrance and 0.6m at the exit. The blade angle at the entrance is 90^0 and the guide vane angle is 15^0. The water at the exit leaves the blades without any tangential velocity. The available head is 30m and the radial component of flow velocity is constant. What would be the speed of wheel in rpm and blade angle at exit? Neglect friction. [7]

7 a) What do you understand by characteristic curves of Francis turbine? Discuss in detail. [7]

b) A model Francis turbine 1/5 of its full size, develops 3kW power at360 rpm under a head of 1.8m. Find the speed and power of full size turbine operating under head of 6m, if (i) the efficiency of the model and the full size turbine are same, (ii) the efficiency of the model turbine is 75% and the scale is considered. [8]

8 a) What do you mean by characteristic curves of centrifugal pumps? What is the significance of characteristic curves? Draw the following characteristics curves for centrifugal pump: Head, Power and Efficiency versus discharge with constant head. [8]

b) Two homologous pumps A and B will run at same speed of 600 rpm. The discharge and head of pump A are 0.4 m3 / sec and 50 m respectively. Determine the discharge of pump B to lift the discharge by 30 m. [7]

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1 a) Distinguish between atmospheric, gauge and vacuum pressure. What do you understand by equality of pressure at the same level in a static fluid? [8]

b) Two pipes on the same elevation convey water and oil of specific gravity 0.88 respectively. They are connected by a U-tube manometer with the manometric liquid having a specific gravity of 1.25. If the manometric liquid in the limb connecting the water pipe is 2 m higher than the other find the pressure difference in two pipes. [7]

2 a) What are the different energies of flowing fluid? Explain each of them [8]

b) Water is flowing through a pipe having diameters 20cm and 10cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 liters/second. The section 1 is 6m above the datum and section 2 is 4m above the datum. If the pressure at section 1 is 40 N/cm^2, find the intensity of pressure at section 2. [7]

3 a) Explain with neat sketch the Reynold's experiment and define Laminar and Turbulent flow. [7]

b) A compound piping system consists of a1600m of 0.4m diameter, 1200m of 0.3m diameter and 800m pf 0.25m diameter cast iron pipes connected in series. Convert the system to (i) an equivalent length of 0.4m pipe and (ii) an equivalent size pipe 3000m long. [8]

4 a) Show that the efficiency of a free jet striking normally on a series of plates fixed mounted on the periphery of wheel never exceeds 50%. [8]

b) What do you understand by velocity triangles? Why these are important in hydraulic turbines?. [7]

5 a) What are the different types of Hydropower plants? Explain each. [8]

b) Differentiate between power house with pondage and power house with storage with neat diagrams. [7]
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6 In a vertical shaft inward-flow reaction turbine, the sum of the pressure and kinetic head at entrance to the spiral casing is 120 m and the vertical distance between this section and the tail race level is 3 m. The peripheral velocity of the runner at entry is 30m/s, the radial velocity of water is constant at 9m/s and discharge from the runner is without swirl. The estimated hydraulic losses are (a) between turbine entrance and exit from the guide vanes 4.8 m(b) in the runner 8.8m (c) in the draft tube 0.79 m (d) kinetic head rejected to the tail race 0.46m. Calculate the guide vane angle and the runner blade angle at inlet and the pressure heads at entry to and exit from the runner. [15]

7 a) A large hydraulic turbine is to generate 300KW at 1000rpm under a head of 40m. For initial testing, a 1:4 scale model of the turbine operates under a head of 10m. Find the power generated by the model. [7]

b) What are the unit and Specific quantities? What is the significance of these quantities hydraulic turbines? Define the specific speed of hydraulic turbine. [8]

8 a) Explain the terms: slip and negative slip with reference to reciprocating pump. [6]

b) A centrifugal pump delivers water against a net head of 10 m at a speed of 1000 rpm. The vanes are curved backward and make an angle of 30 degrees. The impeller outside diameter is 30 cm and has a width of 5 cm at the outlet. Determine the discharge if manometric efficiency is 95%. [9]