Form A: Paper-setting Blank Ref. No. **EX/PE/T/313/2019**

B. E. Power Engineering 3rd year1st Sem. Examination, 2019

Subject: **FLUID MACHINERY**

Time: Three hours Full marks: 100

Answer any Five Questions

No. of questions			Marks
1.	a)	A centrifugal pump having impeller diameter of 127mm develops 14m of head while delivering 2.83lit/s of liquid running at 2000 rpm. If a 102mm diameter impeller is fitted and pump runs at a speed of 2200 rpm, calculate the head and discharge of the new pump assuming the existence of similarity between the pumps.	12++4+4
	b)	Why the deflection of the jet for a Pelton turbine is restricted between 160° and 170°?	
	c)	What is the role of the volute chamber of a centrifugal pump?	
2.		A centrifugal pump lifts water under a static head of 36m of which 4.0m is the suction head. Suction and delivery pipes are both of 130mm diameter having their lengths such that they cause head loss of 1.5m and 7.0 m in suction and delivery pipes respectively. Other data are: impeller overall diameter =0.380m, width at the outlet =25mm, rotational speed=1200rpm and exit blade angle = 38°. Manometric efficiency of pump = 0.80. Determine the discharge and pressure heads at suction and delivery sides of pump. Assume radial inlet type entry and zero area covered by the blade thickness.	20
3.	a)	A Pelton turbine based hydro power plant produces 13,000kW power under a head of 250m when running at 430rpm. Calculate the number of nozzles required, the size of the jets, diameter of the wheel, number of buckets and specific speed if the overall efficiency is 84%. Consider speed ratio, jet ratio and velocity ratio as 0.46, 6 and 0.98 respectively.	15+5
	b)	State the significance of $(NPSH)_{available}$ and $(NPSH)_{required}$.	
4.	a)	Design a Francis turbine runner using the following data: Head: 80m, Rotation speed: 750rpm, Power delivered: 375kW, Overall efficiency: 84%, Hydraulic efficiency: 93%, Ratio of inlet width to inlet diameter: 0.10, Flow coefficient: 0.15,. Also assume that 5% of the total flow area has been occupied by the blade	16+4

		thickness, radial flow at the exit and exit diameter is half of the inlet diameter of the runner.	
	b)	Why the tip of Pelton turbine buckets are two hemispherical cups joined together and are cut?	
5.	a)	Is there any limit to the suction lift of a pump? Discuss.	3+5+4+8
	b)	Discuss the characteristic curves for a centrifugal pump.	
	c)	A jet of water of area $0.125m^2$ and velocity 5m/s strikes a series of radial flat vanes of a wheel moving at a velocity of 2.5m/s. Calculate the force exerted on the series of vanes by the jet and the hydraulic efficiency.	
	d)	Using Eulers' head equation draw the characteristic curves of a centrifugal pump incorporating the slip and hydraulic losses.	
6.	a)	What do you mean by coefficient of drag and coefficient of lift? What are the factors that influence these coefficients?	4+8+8
	b)	What do you mean by forward facing, backward facing and radial blades? How these effects the head developed by a centrifugal pump?	
	c)	A centrifugal pump running at 1000rpm discharges 80lit/s against a net head of 16m. The vane angle at outlet is 35° and the flow velocity is 1.5m/s. If the Manometric efficiency of the pump is 85%, estimate the outer diameter of the impeller and its width at that diameter.	
7.	a)	What are the functions of a draft tube?	4+4+4+8
	b)	What are effects of cavitation?	
	c)	Why the outlet of the draft tube of a reaction turbine is always immersed in tail water?	
	d)	A vertical divergent draft tube 5.6m long is provided to a Francis turbine. The diameters of the draft tube at inlet and exit are 50cm and 70cm respectively. The velocity of water at the exit of the draft tube is 1.25m/s. If the loss of energy in the draft tube is 0.25 times the kinetic head at exit, calculate the efficiency of the draft tube.	