Form A: Paper-setting Blank Ref. No. **EX/PE/T/313/2017(S)**

Power Engineering 3rd Year 1st Sem. Supplementary Examination, 2017
Subject: **FLUID MACHINERY**

Time: Three hours Full marks: 100

Answer any Five Questions

No. of questions			Marks
1.	a)	A Pelton turbine has two runners with two jets per runner. Turbine is feed by water taken by a 3km long penstock with efficiency of transmission through the pipeline is 91%. Each four jets have the same diameter and efficiency of each runner is 90%. The water available for the turbine is $4m^3/s$ and the total head from the reservoir to the nozzle is 250m. The velocity coefficient of each nozzle is 0.975 and the coefficient of friction for the pipe, f (= 4f') is 0.0045. Determine: i) the power developed by the turbine, ii) the diameter of the jet and iii) the diameter of the pipeline.	16+4
	b)	State the significance of $(NPSH)_{available}$ and $(NPSH)_{required}$.	
2.	a)	With the help of mathematical expression, discuss why the blades of the axial flow pumps are twisted in nature.	6+8+6
	b)	A jet of water from a nozzle is deflected through 60° from its original direction by curved plate which enters tangentially without shock with a velocity of 30m/s and leaves with a mean velocity of 25m/s. If the discharge from the nozzle is 08kg/s, calculate the magnitude and direction of the resultant force on the vane, if the vane is stationary.	
	c)	Using Eulers' head equation draw the characteristic curves of a centrifugal pump incorporating the slip and hydraulic losses.	
3.	a)	An inward flow Francis turbine operates at net head of 86.4m and develops a shaft power of 397kW while running at 650rpm. The ratio of wheel width to wheel diameter at inlet of the runner 0.10 and the ratio of inner diameter to outer diameter is 0.5. The hydraulic and overall efficiency of the runner is 95% and 85% respectively and the flow ratio is 0.17. Neglecting blockage by the blade, find the dimensions and blade angles of the turbine. Consider flow velocity is constant and discharge is radial.	16+5
	b)	What is function of the volute casing of a centrifugal pump?	
4.	a)	A conical draft tube discharges water through its outlet (1.8m diameter) at 3m/s. The inlet diameter of the draft tube is 1.2m and total length of the draft tube is 7.2m out of which 1.44m is immersed in water. If the atmospheric pressure head is 10.3m of water and loss	12+8

		of head due to friction in the draft tube is equal to 0.2times the velocity head at outlet of the tube, find (i) pressure head at inlet and (ii) efficiency of the draft tube.	
	b)	What do you mean by flow coefficient, power coefficient and head coefficient of centrifugal pump? Using these dimensionless parameters draw and discuss the performance curves of a centrifugal pump.	
5.	a)	What do you mean by cavitation?	4+16
	b)	A propeller pump delivers $1m^3/s$ at 7m head while running at 960rpm. The outer and hub diameters of the pump are 50cm and 25cm respectively. Find (i) flow ratio, (ii) speed ratio and (iii) horse power required to drive the rum. Assume constant velocity of flow and overall efficiency of the pump as 84%.	
6.	a)	What are different types of blades used for a centrifugal pump? A turbine model of 1:10 size of the prototype is tested under a head of 5m and develops 25hp at 450rpm. If actual turbine works under 40m of head, what will be its speed in rpm and hp produced?	2+6+12
	b)	A jet of water strikes a stationary flat plate held normally to it. Another similar jet strikes a flat plate moving in the direction of jet at one third velocity of jet. The third similar jet strikes a series of flat plates mounted on a wheel and moving at one third velocity of jet. Prove that the forces exerted are in the ratio of 9:4:6.	
7.	a)	What are different types of draft tubes used? State the function of the draft tube.	2+4+14
	b)	Show that the rise of pressure in the impeller of a centrifugal pump when frictional and other losses in the impeller are neglected is given by $$\frac{l}{g}\left[V_{m1}^2 + u_2^2 - V_{m2}^2 \cos ec^2 \beta\right]$$ where V_{m1}^2, V_{m2}^2 are the velocities of flow at inlet and outlet respectively, u_2 is the tangential velocity of impeller at outlet and β is the vane outlet angle.	