B.E.. (E.E.) 4[th] Semester Final Examination, 2010.

Subject: FLUID MECHANICS AND FLUID MACHINES

Code : AM 406
Branch : Electrical

Time : 3 hours. Answer any three questions. Full Marks : _ JC

Q.l.(a)' Explain the term co-efficient of friction. On what factors does this co-efficient depend^ ?

(b) A smooth pipe of diameter 8 cm and 800 m long carries water at the rate of 0.480 m^3/min. Calculate the loss of head, wall shearing stress. Take the value of co-efficient of friction '/* from the relation given as, $/ = \frac{0.0791}{(Re)^*}$, Take kinematic viscosity of water as 0.015 stokes.

Q.2.(a) Find an expression for the ratio of the outlet area of the nozzle to the area of the pipe for maximum transmission of power,

(b) A nozzle is fitted at the end of a pipe of length 300 m and of diameter 10 cm. For the maximum transmission of power through the nozzle, find the diameter of the nozzle. Take /= 0.009.

Q.3.(a) Define the specific speed of a turbine. Derive an expression for the specific speed. What is the significance of the specific speed ?

(b) Pelton turbine installed at Italy, produces I50j000 HP. It works water the head of 720 mts. with speed of 300 r.p.m. It is a double overhung type having one jet per runner. Assuming suitable value of co-efficient of velocity, speed ratio and overall efficiency find the least diameter of the runner, number of bucket and discharge per second.

Q.4.(a) What is flow ratio and what is its importance to hydraulic turbine ? What are the materials used for Francis runner and why are they chosen ?

(b) The Kaplan turbine for hydroelectric plant, manufactured by Heavy Electricals Ltd. has the following specifications : Rated discharge =181 m^3/s, Head = 57.2 m, Speed = 150 r.p.m., Runner hub diameter — 3160 mm, Runner vane tip diameter = 5640 mm, HP produced = 105000. Find (i) Flow ratio, (ii) Speed ratio, (iii) Efficiency and (iv) Specific speed.

Q.5.(a) Show that head developed by a pump is independent of nature of liquid.

(b) A centrifugal pump, having an overall efficiency of 62% is required to m/c oil (sp. gr. = 1.19) and Gasoline (sp. gr. = 0.7). The amount of each of these liquid is 50 lits/sec against a net pressure of 4 kg/cm^2. Show that the same horse power is required for handling both the above liquids having different specific gravity.

Also calculate the head in mt. of fluid to which the m/c oil and Gasoline will be raised.

S E . **C O N P** **y***-*-i

6.(a)Definc the following terms: i) Viscosity, ii) Surface Tension, iii) Capillarity.

(b) The shear stress at a point in an oil is 0.25 Pa and the velocity gradient at that point is 0.2 per second. Find the viscosity of the oil. If the density of the oil is 960 kg/m^3, find the kinematic viscosity of the oil.

7.(a)Prove that the pressure at a point in a static fluid is the same in all directions.

(b) A square plate of each side equal to 0.5 m is immersed in water and is held in a vertical plane such that the upper edge is horizontal and 1 m below the water surface. Compute the total pressure on the plate and the depth of the centre of pressure.

8.(a)Derive Euler's Equation of motion along a streamline mentioning clearly the assumptions used at the places where each assumption is used. Hence derive Bernoulli's Equation mentioning the additional assumption needed.

(b) A 2 m long pipeline tapers uniformly from 10 cm diameter to 20 cm diameter at its upper end. The pipe centre-line slopes upwards at an angle of 30 degree to the horizontal and the flow direction is from smaller to bigger cross-section. If pressure gauges installed at the lower and upper ends of the pipeline read 200 KPa and 230 KPa respectively, determine the flow rate and the ruid pressure at the mid-length of the pipeline. Assume no friction loss.

9. (a)Derive an expression for the head loss when a horizontal pipe abruptly expands into a concentric larger diameter pipe mentioning clearly any assumption used. Also derive an expression for the loss in piezometric head,

(b) Write short notes, using neat diagrams wherever necessary, on (i) Turbulent Flow, (ii) Darcy-Weisbach equation, and (iii) Minor Losses.

10. A horizontal bend in a water pipe deflects the flow through 75° and reduces the diameter from 70 cm to 35 cm. If the discharge is1000 litre/s and the inlet pressure is 190 Kpa, find the magnitude and direction of the force exerted by the water on the bend. Neglect all losses.