Prelim Paper **17411**

3 Hours / 100 Marks **Fluid Mechanics and Machinery**

Instructions : (1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Use of Non-programmable Electronic Pocket Calculator is Permissible.

1. (a) Attempt any **SIX** of the following: **[12]**

(i) State the unit of dynamic viscosity and surface tension.
(ii) Define compressibility and vapour pressure.
(iii) What is gauge pressure and absolute pressure?
(iv) State various losses of energy of fluid flowing in a pipe.
(v) List the applications of Bernoulli's theorem.
(vi) What is impulse turbine and reaction turbine?
(vii) Define : (1) Delivery Head (h_d), (2) Static head (H_s)
(viii) State the advantages of using air vessel in reciprocating pumps.

(b) Attempt any **TWO** of the following: **[8]**

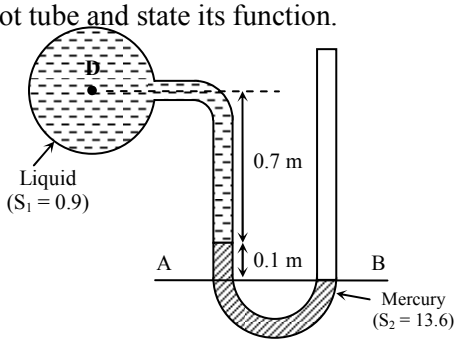
(i) An isosceles triangular plate base 1.4 m and height 2.3 m is immersed in water vertically in such a way that apex is in downward direction and side of base is parallel and 40 cm below free water surface level. Determine total pressure and centre of pressure.
(ii) Determine the height of an oil column of specific gravity 0.8 in (1) meter of Hg (2) in meter of oil column Which will cause a pressure of 25 kPa.
(iii) Explain the various energies possessed by a flowing fluid.

2. Attempt any **FOUR** of the following: **[16]**

(a) The pressure of fluid of specific gravity 0.8 flowing in a horizontal pipeline is determined with a simple U-tube manometer. The level of mercury surface in the right limb open to atmosphere is 90 mm above the centre of pipe. The level of mercury in the left limb, which is connected to pipe is 65 mm below centre of pipe. Determine absolute pressure of fluid in pipe in N/m^2.

(b) Draw a neat, labelled sketch of pitot tube and state its function.

(c) Find the vacuum pressure in a pipe containing a liquid of specific gravity 0.9 as shown in figure.



(d) Explain phenomenon of capillary rise.

(e) Explain Darcy's equation for loss of head due to friction.
(f) A pipe is used for energy transmission. Length and diameter of pipe are 80 m and 45 cm respectively. Flow rate is 105 lit/s. Calculate friction loss. Neglect minor losses. Take f = 0.03.

3. Attempt any **FOUR** of the following: **[16]**
(a) Obtain the condition for maximum transmission of power through the pipe.
(b) A jet of water 50 mm in diameter strikes on a fixed plate normally with a velocity of 25 m/s. Find the force exerted on flat plate.
(c) State laws of fluid friction for turbulent flow.
(d) A pipe 800 m long connects two reserviours whose level difference is 60 m. Find the discharge in pipe in Liters/sec, if diameter of pipe is 0.5 m. Take all losses into account. Assume f = 0.01.
(e) Derive an equation to find force of impact of jet which strikes on a flat plate at right angle which is fixed.
(f) Define hydraulic gradient line and total energy line.

4. Attempt any **TWO** of the following: **[16]**
(a) A centrifugal pump is to discharge 0.130 m^3/s at a speed of 1200 rpm against a total head of 20 meter. The impeller diameter is 250 mm, its width at outlet is 40 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.
(b) Explain with neat sketch the construction and working of multistage pump with application.
(c) A turbine is to operate under a head of 25 cm at 200 rpm. The discharge is 9 m^3/s, if efficiency is 90%, calculate power developed. Also calculate power generated by a turbine, specific speed of the turbine and performance of turbine under a head of 20 m. Also state the type of turbine.

5. Attempt any **FOUR** of the following: **[16]**
(a) Compare centrifugal pump with reciprocating pump (at least four points)
(b) State the functions of draft tube in reaction turbine.
(c) Define cavitation in turbines, also state effects of cavitation.
(d) Draw layout of hydroelectric power plant and state the function of each component.
(e) Draw neat labelled sketch of vortex casing.
(f) Explain the construction and working of single acting reciprocating pump with suitable diagram.

6. Attempt any **TWO** of the following: **[16]**
(a) Why air vessel is required for reciprocating pumps (with neat sketch and working)?
(b) Draw and explain indicator diagram showing combined effect of friction and acceleration head for single acting reciprocating pump.
(c) A centrifugal pump works against 12 m head at 900 r.p.m. The vanes are curved back at an angle of 30° to the tangent at the outer periphery. The impeller diameter is 30 cm and has width 5 cm at outlet. Determine the discharge, if manometric efficiency is 95%. Also determine the power required to operate the pump, if overall efficiency is 65°.

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