25/05/2016 SE MECHATRONICS (CBSGS) SEM-IV
Sub:- F M & M.

Q.P. Code : 723600

(3 Hours) **[Total Marks : 80**

N.B. : (1) Question **No.1** is **compulsory.**
(2) Attempt **any Three** questions from question **No.2** to **6.**
(3) Use Illustrative **diagrams** wherever **required.**

1. (a) Explain variation of viscosity with temperature for gases and liquids? Justify the same and give the relation between viscosity and temperature for liquid and gasses. **5**

(b) Discuss the relative merits and demerits of venturimeter with respect to orifice-meter with the help of neat sketch. **5**

(c) Why pumps are generally less efficient than turbines? **6**
A centrifugal pump is required to deliver 50 liters of water per second to a height of 30 m through a 100 mm long pipe of 15 cm diameter. The inlet losses in the suction pipe are estimated to be 0.35 in. Assuming an overall efficiency of 70 percent and taking Darcy's friction coefficient 0.015 for the pipeline, determine the power required to drive the pump.

(d) Define the following and give one practical example for each : **4**
(i) Laminar flow
(ii) Turbulent flow
(iii) Steady flow
(iv) Uniform flow

2. (a) Classify Pumps and explain the working principle of Reciprocating pump. **8**
(b) Explain how you would find the resultant pressure on a curved surface immersed in a liquid with expression. **8**
(c) What is the difference between pitot-tube and pitot-static tube? **4**

3. (a) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. **10**
(b) Define and explain Reynold's number, Fraude's number and Mach number. Derive expressions for any above two numbers. **8**
(c) Explain the terms : **2**
(i) Path line
(ii) Streak line
(iii) Stream line
(iv) Stream tube

21
15
36

TURN OVER

4. (a) Using. Buckingham's TI theorem, show that the velocity through a circular orifice is given by 12

$$V = \sqrt{2gH\phi}\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

Where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.

(b) Find an expression for the head lost due to friction in suction and delivery pipe. 8

5. (a) What factors decide whether Kaplan, Francis or a Pelton type turbine would be used in hydroelectric project? 10

A Pelton wheel is to be designed for the following specifications. Power = 735.75 kW S.P. Head = 200 m, Speed = 800 rpm, $\eta_0 = 0.86$ and jet diameter is not to exceed one-tenth the wheel diameter.

Determine : (i) Wheel Diameter, (ii) The no of jets required and (iii) Diameter of the jet. Take $C_v = 0.98$ and speed ratio = 0.45.

(b) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that centre of plate is 2 m below the free surface of water. Find the position of centre of pressure also. 4

(c) Determine the displacement thickness and momentum thickness in terms of the nominal boundary layer thickness δ in respect of the following velocity profiles in the boundary layer on a flat plate. 6

6. (a) What is a draft tube? Why is it used in a reaction turbine? Describe with sketch two different types of draft tube. **10**

(b) If the velocity distribution of a fluid over a plate is given by $u = \frac{3}{4}y - y^2$ **4**

where u is the velocity in meter per second at the distance of y meters above the plate, determine the shear stress at y = 0.15 meter. Take dynamic viscosity of the fluid as 8.5×10^{-5} kg-sec/m^2.

(c) What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? **6**
