



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec.-2019

Fluid Mechanics and Hydraulic Machines

Time: 3 hrs

Max. Marks: 100

Note: i) PART - A is compulsory. **Two** marks for each question.

ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

| Q. No. | Questions | Marks |
|----------------------|---|-----------|
| I : PART - A | | 10 |
| I a. | Define specific weight and specific gravity. | 2 |
| b. | Define an expression for total pressure. | 2 |
| c. | Differentiate between Laminar and turbulent flow. | 2 |
| d. | List any four minor energy losses that occur during pipe flow. | 2 |
| e. | Define reciprocating pump and centrifugal pump. | 2 |
| II : PART - B | | 90 |
| UNIT - I | | 18 |
| 1 a. | Explain surface tension on liquid droplet, Hollow Bubble and liquid jet. | 9 |
| b. | A U-tube manometer is used to measure of water in a pipe line, Which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the center of the pipe. Sketch the arrangements. | 9 |
| c. | State Pascal's law and prove that $P_x = P_y = P_z$. | 9 |
| UNIT - II | | 18 |
| 2 a. | Derive an expression of total pressure and center of pressure for Inclined plane surface submerged in liquid. | 9 |
| b. | A rectangular plane surface 2 m wide and 3 m deep lies in water that its plane makes an angle of 30° with the free surface of water. Determine the total pressure and position of center of pressure when the upper edge is 1.5 m below the free water surface. | 9 |
| c. | A solid cylinder of diameter 4.0 m has a height of 4.0 m. Find the meta-centric height of the cylinder if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium in stable and unstable. | 9 |
| UNIT - III | | 18 |
| 3 a. | Deduce an equation for continuity equation in three dimensions. | 9 |

- b. Differentiate between :
- i) Path line and stream line 9
 - ii) Rotational and irrotational flows
 - iii) Steady and unsteady flow
- c. The inlet and throat diameters of a horizontal Venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is 13.734 N/cm^2 While the vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. 9
 Take; $c_d = 0.98$.

UNIT - IV 18

- 4 a. Derive an expression for DARCY-equation for loss of head due to frictions in pipe flow. 9
- b. A Pelton wheel is to develop 13250 kW under a net head of 800 m while running at a speed of 600 rpm. If the coefficient of jet = 0.97, speed ratio = 0.46 and the ratio of jet diameter is 1/15 of wheel diameter. Calculate;
- i) Number of jets 9
 - ii) Diameter of jets
 - iii) Diameter of pitch circle
 - iv) Quantity of water supplied to wheel
- Assume overall efficiency as 85%.
- c. An outward flow reaction turbine has internal and external diameter of the runner as 0.5 m and 1.0 m respectively. The turbine is running at 250 rpm and rate of flow of water through the turbine is $8 \text{ m}^3/\text{s}$. The width of the runner is constant at inlet and outlet and is equal to 30 cm. 9
 The load on the turbine is 10m and discharge at is radial, Determine:
- i) Vane angle at inlet and outlet
 - ii) Velocity of flow at inlet and outlet

UNIT - V 18

- 5 a. Differentiate between reciprocating pumps and centrifugal pump. 9
- b. Explain the following:
- i) Manometric efficiency
 - ii) Volumetric efficiency 9
 - iii) Mechanical efficiency
 - iv) Overall efficiency
- c. The impeller of a centrifugal pump has external and internal diameter 500 mm and 250 mm respectively. Width of outlet 50 mm and running of 1200 rpm. It works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3.0 m/s. The Vanes are set back at an angle of 40° at outlet. Determine; 9
- i) Inlet Vane angle
 - ii) Work done by the impeller on water per second
 - ii) Manometric efficiency