

FLUID MECHANICS

Full Marks: 80

Time: 3 Hours

*Answer any five questions including Q.Nos.1 and 2
Figures in the right-hand margin indicate marks*

Q1 Answer the following questions: (2 x 10)

- a) Define Archimedes principle.
- b) State the conditions of equilibrium of a floating body.
- c) State relation between gauge pressure, absolute pressure and atm. pressure.
- d) Why there is rapid converging passage and gradual diverging passage are provided in venturimeter.
- e) Write continuity Equation for one dimensional flow.
- f) Why is C_d of an orifice meter much smaller than that of venturimeter?
- g) What is the significance of Kinematic viscosity and why we study it though we have dynamic viscosity?
- h) What do you mean by Flow Net, what is its importance?
- i) What is the function of Orifice meter ?
- j) Draw an indicator diagram for reciprocating pump for pump without air vessel and pump with air vessel

Q2 Answer any six : (5 x 6)

- a) Derive Euler's Equation and from there Bernoulli's equation. mention all the assumption and restrictions
- b) Find the density of metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water.
- c) State and explain the conditions of equilibrium of a submerged body.
- d) Classify different types of Manometers.
- e) Draw a neat sketch of velocity diagram showing all components for a jet striking tangentially an unsymmetrical moving curved vane. Draw all three cases of velocity diagram at outlet.
- f) Explain Hydraulic Coefficients.
- g) Derive the equation for C_d of a venturimeter.
- h) Determine the total pressure and position of centre of pressure on a circular plate of diameter 2m which is placed vertically in water in such a way that the centre of plate is 4m below the free surface of water. Find the position of centre of pressure also?

Q3 Derive the expression for coefficient of impact for a jet striking a (10)
i) fixed flat plate, ii) a moving vertical flat plate

Q4 A tank 8 m deep and 2m wide is layered with 3 m of oil of SG=0.7 on top , 3 m of water in middle , and 2 m of mercury at bottom. Compute (a) the total hydrostatic force and (b) the resultant centre of pressure of the fluid on the right-hand side of the tank. **(10)**

Q5 In three dimensional incompressible fluid flow field is given by expression : **(10)**
 $v = (x^2 + y^2 z^3)i + (xy + yz + zx)j + (w)k$. find the w component of velocity so that the case is possible for steady incompressible flow

Q6 A solid cylinder of diameter 4m and height 3m .Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6, State the condition of stability in this case . **(10)**

Q7 Write short note on : **(5x2)**
a) Hydraulic Gradient Line
b) Types of Pipe losses

