Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: IDD (B.Tech and M.Tech)**
Sub_Code: MEPC2003

4th Semester Regular Examination: 2024-25
SUBJECT: Fluid Mechanics and Hydraulic Machines
BRANCH(S): MANUTECH, MECH, MMEAM
Time: 3 Hours
Max Marks: 100
Q.Code: S433

Answer Q1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is Kinematic viscosity?
b) U-tube contains liquid of unknown density. An oil density 815 kg/m^3 is poured into one arm of the tube until the oil column is 14.5 cm high. The oil-air interface is then 6.5 cm above the liquid level in the other arm of the U-tube. Find the density of the liquid.
c) Define the specific speed of the centrifugal pump.
d) What do you mean by manometric efficiency and mechanical efficiency of centrifugal pumps?
e) Define slip of reciprocating pump.
f) Differentiate between the N-S equation and Euler's equation.
g) What is flownet?
h) Differentiate between Eulerian and Lagrangian description of flow
i) At room temperature, the density of liquid water is 0.9976 g/cm$^{3.}$ If the pressure produced by a column of mercury with a height of 760 mm is to be replicated by a column of water, will the height of the water column be greater than, less than, or equal to 760 mm?
j) A 9.52 cm diameter sphere with a mass of 158.3 g is neutrally buoyant in a liquid. What is the density of the liquid?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Derive the capillary height in water, when a small diameter tube is inserted in a fluid medium.
b) A Pelton wheel has a mean bucket speed of 12 m/s and supplied with water at the rate of 0.7 m^3/s under head of 300 m. If the buckets deflect the jet through an angle of 160°, find the power developed and hydraulic efficiency of the turbine.
c) Obtain an expression for the work done per second by water on the runner of a Pelton wheel.
d) State the Newton's law of viscosity. Sketch the Newton's law relationship for Newtonian and Non-Newtonian fluids. Give examples for each fluid.
e) A cylinder of 150 mm radius rotates concentrically inside a fixed cylinder of 155 mm radius. Both cylinders are 300 mm long. Determine the viscosity of the liquid that fills the space between the cylinders if a torque 0.98 N-m is required to maintain an angular velocity of 60 r.p.m.

f) A centrifugal pump delivers 30 L water per second to a height of 18000 mm through a pipe of 90 m in length and 100 mm in diameter. Find the power required to drive the pump. The overall efficiency of the pump is 75%, Assume, f = 0.012.

g) Write a short note on draft tube. Derive the pressure change in draft tube.

h) Derive the differential form of the continuity equation in Cartesian coordinates.

i) Two velocity components are given in the following equations, find the third component such that it satisfies the continuity equation: $u = x^3 + y^2 + 2z^2$, $v = -x^2y - yz - xy$

j) A horizontal venturimeter with a discharge coefficient of 0.98 is being used to measure the flow rate of a liquid of density 1030 kg/m^3. The pipe diameter at entry to the venturi is 75 mm and The venturi throat has an area of 1000 mm^2. If the flow rate is 0.011 m^3/s. Determine the height difference recorded on a U-tube manometer connecting the throat to the upstream pipe. Take the relative density of mercury to be 13.6.

k) Write a short notes on stability of immersed and floating bodiees.

l) Drive the expression of metacentric height for a floating body.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 What do undertand by potential function and stream function? **(16)**
The velocity potential is given as $\Phi = x^2 - y^2$. Determine the stream function. Also calculate the value of the stream functions and the velocity at point (4, 5). Calculate the slope of the stream function. State, if the flow is rotational or irrotational.

Q4 Illustrate and derive the expressions of: **(16)**
i. Unit discharge for a turbine.
ii. Unit speed for a turbine.

Q5 Derive the Bernoulli's energy equation from Euler's motion equation. A horizontal pipe of 250 mm diameter is enlarged suddenly to 500 mm diameter. The flow rate is 0.4 m^3/s. the pressure in a smaller pipe before enlargement is 14.715 N/cm^2. Determine i) loss of head due to sudden enlargement ii) pressure in the larger diameter section. and iii) power loss due to enlargement **(16)**

Q6 A centrifugal water pump has an impeller of outer diameter of 60 cm and inner diameters 20 cm. It is 2 cm wide at outlet and 5 cm wide at inlet. The blade angles at inlet and outlet are 20° and 10° respectively. The impeller rotates at 1800 rpm. Neglecting losses and vane thickness, determine **(16)**

(i) the discharge foe shockless radial entry
(ii) the theoretical head
(iii) the power required
(iv) the pressure rise through impeller