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

Total Number of Pages: 02

Course: B. Tech/ IDD
Sub_Code: RME3C002

3rd Semester Back Examination: 2024-25
SUBJECT: Fluid Mechanics and Hydraulic Machines
BRANCH(S): ME, MECH, ENV, CIVIL, C&EE, MMEAM
Time: 3 Hours
Max Marks: 100
Q.Code: R604

Answer Question No.1 (Part-I) 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) Give the physical significance of surface tension with respect to soap bubble.
b) Differentiate between Kaplan and Francis turbine.
c) Define bulk modulus and compressibility of a hydraulic fluid.
d) What are assumptions in Bernoulli's theorem?
e) What do you mean by stream function?
f) What is flownet?
g) 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?
h) Differentiate between stream line and streak line.
i) What is slip in reciprocating pumps?
j) Differentiate Pelton, Francis and Kaplan Turbine on the basis of head of water and specific speed.

Part-II

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

a) What is metacentre? Derive metacentric height for a floating equilibrium body.
b) What is a hydraulic intensifier? Explain with a sketch.
c) Derive the differential form of the continuity equation in Cartesian coordinates.
d) What do you understand by minor losses in pipelines? Explain.
e) State the Newton's law of viscosity. Sketch the Newton's law relationship for Newtonian and Non-Newtonian fluids. Give examples for each fluid.
f) What is specific speed of a pump? Why is it necessary? How is it calculated?
g) Within a stationary cylinder with a radius of 155 mm, a cylinder with a radius of 150 mm rotates concentrically. The length of both cylinders is 300 mm. Find the viscosity of the liquid that fills the space between the cylinders if maintaining an angular velocity of 60 r.p.m. requires a torque of 0.98 N-m.
h) A 90-meter-long, 100-mm-diameter pipe is used to supply 30 L of water per second to a height of 18,000 mm using a centrifugal pump. Determine the amount of power needed to run the pump. The pump's overall efficiency, assuming f = 0.012, is 75%.

i) Liquid water has a density of 0.9976 g/cm^3 at normal temperature. Will the height of the water column be larger than, less than, or equal to 760 mm if the pressure created by a mercury column with a height of 760 mm is to be duplicated by a water column?

j) A horizontal venturi meter 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) In which type of turbines, draft tubes are used? Derive the pressure change phenomenon in it.

l) Differentiate between centrifugal pump and reciprocating pump.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Derive for the following expressions: **(16)**

I. Turbine unit discharge.
II. Turbine unit speed.

Q4 Euler's motion equation can be used to get Bernoulli's energy equation. A 250 mm horizontal pipe is abruptly increased in diameter to 500 mm. The rate of flow is 0.4 m^3/s. Prior to enlargement, the pressure in a smaller pipe was 14.715 N/cm^2. Assess i) head loss as a result of abrupt expansion ii) pressure in the part with a greater diameter. and iii) enlargement-related power loss **(16)**

Q5 Find an expression for the amount of effort that water does on a Pelton wheel's runner per second. A Pelton wheel receives water at a rate of 0.7 m^3/s under a head of 300 m and has a mean bucket speed of 12 m/s. Determine the turbine's power generation and hydraulic efficiency if the buckets deflect the jet at a 160° angle. **(16)**

Q6 A large pipe was originally made up of two parallel pipes that are now a part of another pipe. One parallel pipe is 2000 meters long and 1 meter in diameter, and the other parallel pipe is also 2000 meters long and 0.8 meters in diameter. Assuming that the main's overall flow is 3 m^3/s and that each parallel pipe's coefficient of friction is equal to 0.005, calculate the flow rate in each pipe. **(16)**