Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (AUE)/SEM-3/AUE-302/2010-11

2010-11

FLUID MECHANICS AND MACHINERY

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

All the notations have their usual meaning.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Poise is the unit of

      a) Surface tension b) Capillarity

      c) Viscosity d) Buoyancy.

   ii) The surface tension of mercury at normal temperature compared to that of water is

      a) more

      b) less

      c) same

      d) more or less depending on the size of glass tube.

iii) Pitot tube is used to measure

a) discharge b) average velocity

c) velocity at a point d) pressure at a point.

iv) An ideal flow of any fluid must satisfy

a) Pascal's law

b) Newton's law of viscosity

c) Continuity equation

d) Bernoulli's equation.

v) Rotameter is used for measuring

a) Density of fluids

b) Velocity of fluids in pipes

c) Discharge of fluids

d) Viscosity of fluids.

vi) For an irrotational flow $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0$ is the equation given by

a) Cauchy-Riemann b) Reynolds

c) Laplace d) Bernoulli.

vii) Continuity equation can take the form

a) $Q = \rho AV$ b) $\rho_1 A_1 = \rho_2 A_2$

c) $A_1 V_1 = A_2 V_2$ d) $\rho_1 A_1 V_1 = \rho_2 A_2 V_2$.

viii) The specific speed (N_s) of a turbine is given by

a) $N_s = N\sqrt{P} / H^{\frac{3}{4}}$ b) $N_s = N\sqrt{Q} / H^{\frac{3}{4}}$

c) $N_s = N\sqrt{P} / H^{\frac{5}{4}}$ d) $N_s = NP^{\frac{5}{4}}\sqrt{H}$.

ix) Air-vessels in reciprocating pump are used to

a) Smoothen flow

b) Reduce acceleration to minimum

c) Increase pump efficiency

d) Save pump from cavitation

e) Increase pump head.

x) Ratio of inertia force to elastic force is known as

a) Mach number b) Froude number

c) Reynold's number d) Weber's number.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Develop an expression for the differential form of two dimensional continuity equation.

3. What are the conditions of equilibrium of floating body and submerged body ? Explain with sketches.

4. Calculate the kinetic energy correction factor α for the velocity distribution $\frac{u}{u_m} = \left(1 - \frac{r}{r_0}\right)$ in a circular pipe radius r_0.

5. With a neat sketch, describe the principle of operation of an external gear type positive displacement pump.

6. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter given reading of 19·62 N/cm^2 and 9·81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0·6. Find discharge of water through pipe.

GROUP – C

(Long Answer Type Questions)

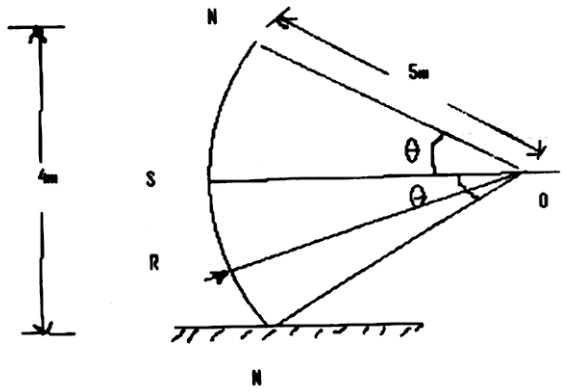
Answer any *three* of the following. 3 × 15 = 45

7. a) Derive from first principles Bernoulli's equation for fluid motion along a streamline.

   b) A 45° reducing pipe bend (in a horizontal plane) tapers from 600 mm diameter at inlet to 300 mm diameter at outlet. The pressure at inlet is 140 kN/m^2 and the rate of flow of water through the bend is 0·425 m^3/s. Neglecting friction, calculate the resultant force exerted by water on the bend. 8 + 7

8. a) Derive an expression for the force exerted on a submerged inclined surface by the static liquid and locate the position of centre of pressure.

   b) A sector gate in the form of a circular arc of radius 5 m retains water to a height 4 m above its sill as shown in figure below. Calculate the magnitude and direction of the resultant force per unit length of the gate. 8 + 7



9. a) Wooden block in the form of a rectangular prism floats with its shortest axis vertical. The block is 40 cm long, 20 cm wide and 15 cm deep with a depth of immersion of 12 cm. Calculate the position of metacentre and comment on the stability of the block.

   b) A lawn sprinkler has tow identical nozzles of diameter 7·5 mm each provided at the ends of the sprinkler rotor. One nozzle discharges water vertically upward while the other nozzle discharges water in the downstream direction. The velocity of flow from each nozzle is 10 m/s and nozzle are at a radial distance of 20 cm and 15 cm from the centre of rotor.

      i) Determine the torque to be exerted so as to hold the system in stationary position

      ii) Also determine the constant speed of rotation of the arm if it is free to rotate. 7 + 8

10. a) The impeller of a centrifugal pump is single inlet type, having inlet and outlet diameters 700 mm and 1200 mm respectively. At outlet, the width is 200 mm relative flow angle is 25° and absolute flow angle is 10·5°. The pump runs at 480 rpm with an efficiency of 77%. Considering 5% blockage at outlet, calculate the pump discharge, head and specific speed.

   b) With picture describe the working principle of a centrifugal pump. 10 + 5

11. Write short notes on any *three* of the following : 3 × 5

a) Centre of buoyancy and Metacentre

b) Streamline, Pathline, Streakline

c) Fransis turbine

d) Buckingham's theorem

e) Cavitation.