QP Code:536900

(REVISED COURSE)
(3 Hours) **[Total Marks: 80**

N.B. :

1) **Question – 1 is compulsory**. Answer any **three** questions from remaining.
2) Assume data if necessary and **specify the assumptions** clearly.
3) Draw neat sketches wherever required.
4) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.

1. (a) What is capillary effect? **[02]**
   (b) Explain Pascal's law. **[02]**
   (c) What is uniform and non-uniform flow? **[02]**
   (d) Explain stream tube? **[02]**
   (e) Why divergent section of venturi meter is longer than convergent section? **[02]**
   (f) What is skin friction and form friction? **[02]**
   (g) What is fully developed flow? **[02]**
   (h) Explain terminal settling velocity. **[02]**
   (i) How will you make the centrifugal pump work if available NPSH is less than the required one? **[02]**
   (j) What is minimum speed of centrifugal pump? **[02]**

2. (a) Pipe A and B contain water under pressure of 274.68 kN/m^2 and 137.34 kN/m^2 respectively. Pipe A which is at an elevation of 12 m is connected to left limb of U-tube manometer whereas pipe B at an elevation of 10 m is connected to right limb. Level of mercury in right limb is y m above the centreline of pipe B and x m below the centreline of pipe A. What is the deflection of the mercury (h) in the differential manometer? **[15]**
   (b) Discuss the boundary layer over flat plate. **[05]**

3. (a) The following cases represent the two components of velocity of incompressible flow. Determine the third component of velocity such that they satisfy the continuity equation, **[15]**
   i) $u_x = x^2 + y^2 + z^2, \quad u_y = xy^2 - yz^2 + xy$
   ii) $u_y = 2y^2, \quad u_z = 2xyz$
   iii) $u_x = \ln(y^2 + z^2), \quad u_y = \ln(x^2 + z^2)$
   (b) Explain Newtonian and non-Newtonian fluids with shear stress vs shear rate diagram? **[05]**

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4. (a) A pipeline of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the percent increase in discharge if Darcy friction factor is 0.04. The head at inlet is 300 mm. **[10]**

   (b) For a turbine agitator installed in a vertical tank, speed is 90 RPM. Diameter of tank is 1.8 m and diameter of turbine is 0.61 m. Density of liquid is 1498 kg/m^3, and viscosity is 120 Pa-s. If the power number is given by $N_P = 65/N_{Re}$, calculate the power required for agitation. **[05]**

   (c) Explain gate valve and globe valve with neat sketch. **[05]**

5. (a) A gas is flowing through a horizontal pipe at a temperature of 4°C. The diameter of the pipe is 8 cm and at a section (1) in this pipe, the pressure is 303 kPa g. The diameter of the pipe changes from 8 cm to 4 cm at the section (2), where pressure is 203 kPa g. Find the velocities of the gas at these sections assuming an isothermal process. take R = 287.14 N-m/kg-K, and atmospheric pressure is 101.3 kPa. **[15]**

   (b) Estimate the terminal velocity for 50 μm particle of limestone (ρ_p = 2800 kg/m^3) falling in water at 30°C. Assume, density of water 1000 kg/m^3 and viscosity 1 cP. **[05]**

6. (a) Water flows steadily with negligible viscous effects through the pipe from location (1), inlet, to location (2), which is outlet (a free jet). Diameter of pipe at location (1) is 38.1 mm and piezometer connected to pipe at this location show the liquid head of 4.572 m. Outlet of pipe is 3.048 m above the inlet. Determine the diameter, D, of the pipe at the outlet, if the velocity there is 6.096 m/s. **[15]**

   (b) Explain Moody's diagram? **[05]**