Fluid Mechanics
(ME-208, Dec-07)

Note: Section A is compulsory. Attempt any four questions from Section B and any two from Section C.

Section-A

1. a) Define dynamic and kinematic viscosity. Also state their units in S.I & cgs system.
   b) Define center of pressure. How it is different from centre of gravity.
   c) Define meta centric height.
   d) Define circulation. How is it related to vorticity?
   e) Give an example in which the path lines, stream lines and streak lines are involved simultaneously in a single diagram.
   f) State Bernoulli's theorem and give its applications.
   g) Define Froude's number and its significance.
   h) State minor losses in pipe flow.
   i) Why the kinetic energy correction factor and the momentum energy correction factor are used.
   j) Which among Venturi-meter, orifice meter and rota meter is the most accurate and write down coefficient of discharge for each one?

Section-B

2. A tank contains water upto a height of 0.5 m above the base. An immiscible liquid of Sp. gravity 0.8 is filled on the top of water upto 1 m height. Calculate: (a) Total pressure on one side of tank, (b) The position of centre of pressure for one side of the tank, which is 2 m wide.
3. What are the conditions of equilibrium for floating and submerged bodies?
4. If a cylinder is 8 cm in diameter and 10 cm deep and is exactly half full of water, find the speed of rotation (rpm) at which water just begin to spill over the top edge.
5. The velocity components of a three dimensional, incompressible flow are as:
   $u = x^2 + y^2 + z^2$ and $v = -(xy + yz + zx)$
   Make calculations for the third component of velocity that satisfies continuity. Can a stream function be defined for such a flow?
6. Write the impulse momentum equation and the moment of momentum equation? What is the difference between them in terms of variable to be found?

Section-C

7. (a) A pitot tube is inserted in a pipe of 30 cm diameter. The static pressure in the pipe is 10 cm of mercury. The stagnation pressure at the centre of pipe, recorded by pitot tube is 0.981 N/cm^2. Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the centre velocity. Take $C_V = 0.98$.
   (b) A 20 cm x 10 cm venture- meter is inserted in a vertical pipe carrying oil of sp. gravity 0.8; the flow of oil is in the upward direction. The difference of levels between the throat and inlet section is 50 cm. The oil mercury differential manometer gives a reading of 30 cm of mercury. Find the discharge of oil. Neglect losses.
8. A horizontal pipe line 40m long is connected to a water tank at one end and discharge freely into the atmosphere at other end. For the first 25 m of its length from the tank, the pipe is 15 cm in diameter and then suddenly enlarged to 30 cm. the height of water level in the tank is 8 m above the center of pipe, considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe.
9. (a) State Buckingham's PI theorem?
   (b) Show by Buckingham's PI theorem that the velocity through an orifice is given by

$$V = \sqrt{2gH}\ f\left(\frac{D}{H}, \frac{\mu}{\rho V H}\right), \frac{\sigma}{\rho V^2 H}$$