8. The thrust T of a propeller depends on its dia. D, the fluid density ρ, dynamic viscosity μ the revolutions per unit time N, and the velocity of advance with V respect to the undisturbed fluid. By means of dimensional analysis, show that the appropriate non-dimensional parameter are:

$$T = \rho D^2 V^2 f\left(\mu/VD\rho, DN/V\right)$$

Unit - V

9. a) What is the critical velocity of flow in a circular pipe? What are the upper and lower critical velocity values?

   b) The lower end of a vertical shaft of dia. 10cm rests in a foot step bearing. The clearance between the lower end of the shaft and the bearing surface is 0.5mm. If the shaft has to run at 750rpm. Find the torque required to keep the shaft in motion. Find also the power required.

   Take dynamic viscosity of oil as 1.5 poise.

OR

10. A pipe 10cm in dia. and 1000m long is used to pump oil of viscosity 3.5 poise and specific gravity 0.92 at the rate of 1200 lit/min. The first 300m of the pipe is laid along the ground sloping up-wards at 10° to the horizontal and the remaining pipe is laid on the ground sloping upwards at 15° to the horizontal. State whether the flow is laminar of turbulent? Determine the pressure required to be developed by the pump and the power of the driving motor if the pump efficiency is 60 percent. Assume suitable data for friction coefficient, if required.

******

Roll No ....

AU/CE/IP/ME-405

B.E. IV Semester

Examination, June 2013

Fluid Mechanics

Time : Three Hours

Maximum Marks : 70/100

Note: Attempt any five questions.
All questions carry equal marks.

Unit - I

1. a) Define and distinguish between the following set of fluid properties :

      i) Specific weight and mass density

      ii) Dynamic viscosity and kinematic viscosity.

   b) A cylinder contains 0.75 m^3 of gas at $20^{\circ}C$ and 2.5 bar pressure. After compression, the volume gets reduced to 0.15 bar. Determine final pressure and bulk modulus of compressed air if compression takes place under :

      i) Isothermal conditions

      ii) Adiabatic conditions (Y=1.4)

OR

2. A closed oil tanker 2m deep x 1.8m wide and 3.5m long has been filled with an oil of specific gravity 0.8 upto a depth of 1.6m. Calculate the acceleration which may be imported to

the tank in the direction of its length so that bottom front end of the tank is just exposed. Also calculate the net horizontal force acting on the tanker sides and show that this equals the force necessary to accelerate the liquid mass in the tanker for water specific weight = 9807 N/m^3

Unit - II

3. a) What characterises the stagnation point? Determine the equation of streamline for a two dimensional flow field for which the velocity components are given by :

   i) u = a and v = a where a is a non-zero constant. The stream line passes through the point (1,3).

   ii) $u = \frac{-y}{b^2}$ and $v = \frac{x}{a^2}$. the streamline passes through the point (a, 0).

   iii) $V_r = \frac{\cos\theta}{r^2}$ and $V_\theta = \frac{\sin\theta}{r^2}$. The streamline passes through r = 2 and $\theta = \frac{\pi}{2}$.

   b) The velocity distribution for a three-dimensional flow is given by :

   $\vec{V} = ax i + ay i - 2az k$

   Find the equation of streamline passing the through the position vector $\vec{r} = 2i + 2j + 4k$

OR

4. a) Differentiate between the Eulerian and Lagrangian method of representing fluid motion.

   b) Define the stream function and clearly bring out its physical significance. Enumerate some of the salient features of the stream function.

Unit - III

5. A 30cm diameter pipe carries water under a head of 20 metres with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force on the bend.

OR

6. a) Derive Euler's equation of motion along a streamline, and hence derive the Bernoulli's theorem.

   b) Explain the difference between system and control volume approaches.

Unit - IV

7. a) What are the various methods of dimensional analysis to obtain a functional relationship between various parameters affecting a physical phenomenon.

   b) Explain the significance of dimensional analysis as applied to fluid flow problems.

OR