d) Derive the Hagen Poiseuille formula.

OR

Two parallel plates kept 100mm apart have laminar flow of oil between them, maximum velocity of 1.5 m/s. Calculate

i) Discharge per meter width

ii) Shear stress at the plate

iii) Velocity gradient of plate

Assume viscosity of oil is 24.5 poise

******

Roll No .....

AU/CE/IP/IEM/PR/ME-405

B.E. IV Semester

Examination, June 2016

Fluid Mechanics

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Define the Newton's law of viscosity.

b) State the Pascal's law and its application.

c) What is a manometer? How are they classified?

d) Prove that the vertical component of the resultant pressure on a submerged curved surface is equal to the weight of the liquid supported by curved surface.

OR

A wooden cylinder of specific gravity of 0.6 and circular in cross section is required to float in oil of specific-gravity of 0.90. Find the length (L)/D(diameter) ratio for cylinder to float with its longitudinal axis vertical in oil.

2. a) Distinguish between
   i) Steady flow and unsteady flow
   ii) Uniform flow and non-uniform flow
   b) Define the term velocity potential function and stream function.
   c) Distinguish between rotational flow and irrotational flow.
   d) In a two dimensional incompressible flow, the fluid velocity components are given by

   $u = x - 4y$

   $v = -y - 4x$

   Show that velocity potential exists and find its form.

   OR

   Define the source flow. Derive the equation of steam function. Also plot the steam lines.

3. a) State the Bernoulli's equation of fluid flow.
   b) State the Impulse-Momentum principle.
   c) State the moment of momentum equation and its application.
   d) Discuss the working principle of venturimeter and derive the equation for actual discharge through it.

   OR

   Oil of specific gravity = 0.82 flow through a 0.8m diameter pipe at the end of which there is a reducer connecting to 0.5m pipe. If the gauge pressure at the entrance to the reducer = 410kN/m^2 and velocity is 2.5 m/sec. Determine the resultant thrust of the reducer. Take frictional head loss in reducer is 1.6m.

4. a) Define the terms dimensional analysis and model analysis.
   b) What are advantages of dimensional analysis?
   c) State the Buckingham Pi- theorem.
   d) Fluid of density ρ and viscosity μ flows at an average velocity V through a circular pipe diameter d. Show by dimensional analysis, that the shear stress of the pipe wall is

$$\psi_0 = \rho \cdot V^2 \cdot f\left(\frac{\rho \cdot V \cdot d}{\mu}\right)$$

   OR

   A 1:15 model of a flying boat is towed through water the prototype is moving in sea water of density 1024 kg/m^3 at a velocity of 20 m/s.

   Find the corresponding speed of the model. Also determine resistance due to waves on model, If the resistance due to waves of prototype is 600N.

5. a) Distinguished between laminar and turbulent fluid flow.
   b) State the shear stress and its distribution over a fluid flow through circular pipe.
   c) A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30mm diameter pipe. If the pressure drop per meter length of pipe is 20kN/m^2. Determine the discharge.