Chapter -6

TWO DIMENSIONAL IDEAL FLUID FLOW

Q.1 Explain equipotential lines and lines of constant stream function.

Q.2 DEFINE:-
1. Stream function (ψ)
2. Potential function (Φ)
3. Circulation (Γ)
4. Vorticity (ξ)
5. Flow net

Q.3 What is flow net? Explain it and state the importance of it.

Q.4 Prove that circulation $\Gamma = \oint \xi \, dA$ with usual notations and state the importance of circulation.

Q.5 A stream function is given by $\psi = 3xy$

DETERMINE:-
1. Weather the flow is possible or not
2. Weather the flow is rotational or irrotational
3. The potential function (Φ)
4. Acceleration at point (1,1)

[ANS:- POSSIBLE, IRROTATIONAL, $3/2(x^2 - y^2) + C$, 9 UNIT, 9 UNIT]

Chapter -7

DIMENSIONAL ANALYSIS AND SIMILARITIES

Q.1 State the buckingham’s $\pi$ – theorem. Describe the procedure for selecting repeating variables.

Q.2 DEFINE:-
1. Reynolds number (Re)
2. Froude number (Fr)
3. Mach number (M)
4. Weber number (We)
5. Euler number (Eu). State the importance of each.

Q.3 State the various similarity laws (all five) and also state its applications.

Q.4 Discuss different types of similarities that must be existing between a prototype and its model.

Q.5 Using Buckingham’s $\pi$-theorem, show that the lift $F_L$ on airfoil can be expressed as

$F_L = \rho V^2 d^2 \Phi[(\rho V d / \mu), \alpha]$  

Where $\rho$= mass density $V$= velocity of flow, $d$=characteristic depth $\mu$ =co-efficient of viscosity and $\alpha$ =angle of incidence

Q.6 A pipe of 1.4m in diameter is required to transport an oil of specific gravity 0.8 and dynamic viscosity 0.04 poise at the rate of 2500 liters per second.
Tests were conducted on a150mm diameter pipe using water at 20°C.
The viscosity of water at 20°C is 0.01 poise.
Find the rate of flow in the model.
Chapter -8

VISCOUS FLOW

Q.1 Derive the following for the flow of viscous fluid through a circular pipe
   1. Shear stress
   2. Velocity distribution
   3. $U_{\text{max}}$
   4. Average velocity
   5. Pressure drop ($\Delta p$) (Hagen Poiseville Law)
   Also show that $f = \frac{1}{6}\frac{1}{Re}$ for laminar flow.

Q.2 Derive the following for the flow of viscous fluid between two parallel plates
   1. Shear stress
   2. Velocity distribution
   3. $U_{\text{max}}$
   4. Average velocity
   5. Pressure drop ($\Delta p$)

Q.3 Explain the dash pot mechanism and its utility.

Q.4 A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/sec.
   Find the mean velocity and the radius at which this occurs.
   Also calculate the velocity at 4 cm from the wall of the pipe.

   [ANS:- 0.75 m/s, 0.0707 m, 0.48 m/s]

Q.5 Two parallel plates kept 100 mm apart have laminar flow of oil between them. Maximum velocity of flow is 1.5 m/sec.
   CALCULATE:
   1. Discharge per meter width
   2. Shear stress at the plate
   3. Velocity gradient
   4. Pressure drop between points 20 m apart
   5. Velocity at 20 mm from plates

   [ANS:0.1 m$^3$/s, 147 N/m$^2$, 60/s, 58.8 kPa, 0.96 m/s]

Q.6 A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of diameter 181.2 mm. Both the cylinders are 300 mm high.
   Determine the viscosity of fluid if a torque of 20 Nm is required to rotate the inner cylinder at 120 rpm.

   [ANS:0.6957 PaS]

Chapter -9

TURBULENT FLOW

Q.1 Derive the expression for darcy-weisbach equation.

Q.2 Explain the prandtl’s mixing length theory.

Q.3 What do you mean by hydrodynamically smooth and rough pipe?
Q.4 Calculate the loss of head and power required to maintain the flow in a horizontal pipe of diameter 40 mm and length 750 m at a rate of 30 Litre/minute. Take $f = 0.032$  

[ANS: -4.9 m, 0.024 kW]

Chapter -10
FLOW THROUGH PIPES

Q.1 Explain the Hydraulic gradient line (HGL), Total energy line (TEL) and Datum head ($Z$) with the help of diagram.

Q.2 Explain the major and minor energy losses through pipe.

Q.3 Write a short note on the following
   4. Equivalent pipe         5. Flow through branched pipes

Q.4 Prove that maximum efficiency of power transmission through pipe is 66.67%.

[ANS: 132 kPa, 359 K, 1.276 kg/m$^3$]