Exam. Code: 0940
Sub. Code: 6715

2023
B.E. (Mechanical Engineering)
Fourth Semester
MEC-405: Fluid Mechanics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.***

x-x-x

1. (a) Can two streamline intersect with each other. Comment on the statement with valid reason.
   (b) What are the Hydraulic Gradient and Energy Gradient Lines?
   (c) Differentiate between Dynamic and Kinematic viscosity. State their units of measurements.
   (d) Define the terms for an Aero-foil: a) Chord Line b) Angle of Attack
   (e) What are Shock Waves. Mentions its types also.

(5x2)

UNIT -I

2. Show that the power P developed in a water turbine can be expressed as:

$$P = \rho N^3 D^5 \emptyset \left[\frac{D}{B}, \frac{\rho D^2 N}{\mu}, \frac{ND}{\sqrt{gH}}\right]$$

where **D** and **B** are the diameter and width of the runner, **N** is the speed in revolutions per minutes, **H** is the operating head, **μ** and **ρ** are respectively the coefficient of dynamic viscosity and mass density of the liquid, **g** is the gravitational acceleration. (10)

3. (a) In a two-dimensional in-compressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function.

   (b) A plate, **0.05 mm** distant from a fixed plate, moves at **1.2 m/s** and requires a force of **2.2 N** per unit area i.e., **2.2 N/m²** to maintain this speed. Determine the fluid viscosity between the plates.

(6, 4)

4. (a) Explain the conditions of equilibrium for floating and submerged bodies.
   (b) A unform body of size **3 m long X 2 m wide X 1 m deep** floats in water. What is the weight of the body if depth of immersion is **0.8 m**. Determine the meta-centric height also.

(4, 6)

P.T.O.

UNIT - II

5. (a) List the assumptions which are made while deriving Bernoulli's equation. How the Bernoulli's equation is modified while applying in the practice. List out the engineering applications.

(b) An oil having relative density **0.9** and dynamic viscosity **0.18 kg/ms** is pumped through a horizontal pipe of **8 cm** diameter. Workout the pressure drop and power required to maintain the flow if the oil is to flow at the rate of **4 kg/s** through **800 m** in length of the pipe. Presume that critical Reynolds number has the value 2320. (4, 6)

6. (a) Discuss the Prandtl mixing length concept in detail.

(b) Find out the Displacement Thickness, the Momentum Thickness, and the Energy Thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$ where "**u**" is the velocity at a distance "**y**" from the plate and $u = U$ at $y = \delta$, where δ is the boundary layer thickness. Also calculate the ratio of displacement thickness to the momentum thickness. (4, 6)

7. (a) Differentiate between Minor and Major Losses.

(b) A cruise missile under test is moving horizontally with Mach number **2** in the atmosphere at an elevation of **300 m** above the earth's surface. How long does it take for an observer to feel the disturbance from the instant when it is directly overhead? How far will the missile be from the observer at the instant of disturbance reaching him.? Assume atmospheric temperature to be **288 K**. and take **R=287 J/kg-K** (4,6)

x-x-x