R17

Code No: 5421AC

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, June/July - 2019

ADVANCED FLUID MECHANICS

(Thermal Engineering)

Time: 3hrs Max.Marks:75

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) What is the difference between Eulerian and Lagrangian description of fluid flow? Explain. [5]

b) State the momentum equation and mention some of its engineering application. [5]

c) Explain briefly about Oseen's approximation. [5]

d) Explain the significance of Time Averaged Equations. [5]

e) Show that a normal shock can occur only in supersonic flow and that after the shock there must be subsonic flow. [5]

PART - B

5 × 10 Marks = 50

2.a) A stream function ψ in a two-dimensional flow is given by $\psi = 2xy$. Show that the function satisfies the continuity equation and that the flow is irrotational. Workout the corresponding velocity potential function?

b) Deduce the general three-dimensional equation of continuity and deduce from it the continuity equation for one dimensional frictionless flow? [5+5]

OR

3.a) State Buckingham's π- theorem and explain the procedure in detail for solving the problems by using Buckingham's π- theorem.

b) The efficiency of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensional parameters. [5+5]

4.a) Explain the Plain Poisoulle flow and also explain the velocity distribution and drop of pressure in the pipe flow.

b) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. [5+5]

OR

5.a) Explain and derive the expression for the velocity distribution and ratio of Maximum Velocity to Average Velocity.

b) Determine (i) the pressure gradient, (ii) the shear stress at the two horizontal parallel plates and (iii) the discharge per metre width for the laminar flow of oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100 mm apart. Given μ = 2.4525 Ns/m^2. [5+5]

6.a) Explain about the Prandtl's contribution to real fluid flow.

b) Explain about the Boundary layer development over a flat surface. [5+5]

OR

7.a) Explain about the methods of controlling the Boundary Layer.

b) Air flows over a flat plate 1 m long at a velocity of 6 m/s. Determine: (i) the boundary layer thickness at the end of the plate (ii) shear stress at the middle of the plate (iii) total drag per unit length on the sides of the plate.
Take ρ = 1.226 Kg/m^3 and $\nu = 0.15 \times 10^{-4}$ m^2/s for air. [5+5]

8.a) Explain about Universal Velocity Distribution Law.

b) Water flows through a pipe of diameter 250 mm. The local velocities at the centre and mid radius are 2.1 m/sec and 2.09 m/sec. find the discharge and the pipe roughness. [5+5]

OR

9.a) Explain about Van Driest Model.

b) A smooth brass pipeline 75 mm in diameter and 900 m long carries water at the rate of 7 litres per second. If the kinematic viscosity of water is 0.0195 stokes, calculate the loss of head, wall shearing stress, centre line viscosity, shear stress and velocity at 25 mm from the centre line and the thickness of the laminar sublayer. Take ρ = 1000 kg/m^3. [5+5]

10.a) Explain about the pressure wave propagation in a compressible flow in detail.

b) At the sea level if the pressure of the atmosphere is 1.025 kg/cm^2 and the temperature is 15^{0}C. Find the pressure at the height of 3000 metres (i) assuming an isothermal change (ii) assuming an adiabatic change. [5+5]

OR

11.a) Explain about expansion and compression of a perfect gas in detail.

b) Explain in a supersonic flow condition, the terms 'Zone of silence' and 'Zone of action'. [5+5]

---ooOoo---