Code No: 5421AC **R17**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Semester Examinations, January - 2018
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) For the flow represented by stream function, $\psi = xy$, determine the vorticity of components. [5]

b) What changes has to be made in Navier-Stokes equation for in-compressible flow, in order to get Euler equation for that flow. Do you think that Euler's equation of fluid motion satisfy no-slip condition at wall? Explain it. [5]

c) What are the factors effecting boundary layer thickness? Explain. [5]

d) Briefly explain the velocity distribution for turbulent flow in Rough pipes. [5]

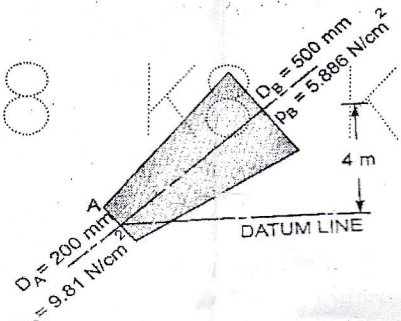
e) Explain why air flowing at low velocities can be considered as incompressible. [5]

PART - B

5 × 10 Marks = 50

2.a) State Velocity potential function with equations and also show with derivation that when rotational components are zero then the flow is irrotational.

b) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is 4 metres at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and the direction of flow. [5+5]



OR

3.a) Write the methods of describing the fluid motion and explain which method is used in fluid mechanics and also explain the different types of fluid flow.

b) The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ, and bulk modulus of air K. Express the relation between these variables and the resisting force. [5+5]

4.a) Obtain an expression for the value of pressure drop in an incompressible, laminar and steady couette flow such that shear stress at the stationary plate is zero.

b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. [5+5]

OR

5.a) Discuss the premises underlying the formulation of the Navier Strokes equation. Explain why its exact solution is not possible?

b) The radial clearance between a hydraulic plunger and the cylinder walls is 0.1 mm, the length of the plunger is 300 mm and diameter 100 mm. Find the velocity of leakage and rate of leakage past the plunger at an instant when the difference of the pressure between the two ends of the plunger is 9 m of water. Take $\mu = 0.0127$ poise. [5+5]

6.a) Derive Von Karman momentum integral equation for a boundary layer.

b) Write the boundary conditions which must be satisfied by any velocity profile. [5+5]

OR

7.a) Define local and mean drag co-efficient and write its formulae.

b) For the velocity profile for laminar boundary layer

$\frac{u}{U} = 2(y/\delta) - 2(y/\delta)^3 + (y/\delta)^4$

Obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and co-efficient of drag in terms of Reynold number. [5+5]

8.a) Explain about the Prandtl's Mixing length theory. How is the mixing length dependent on the distance from the pipe wall.

b) What do you mean by Eddy Viscosity? How does it differ from the viscosity of the fluid? [5+5]

OR

9.a) What do you understand by hydrodynamically smooth and rough pipes.

b) Describe Nikuradse's experiments on the resistance of artificially roughened pipes and explain how it is different from Moody's diagram. [5+5]

10.a) Explain about Stagnation properties and derive an expression for Stagnation Pressure and Stagnation Density.

b) Find the Mach number when an Aeroplan is flying at 1100 Km/hour through still air having a pressure of 7 N/cm^2 and temperature -5^{0}C. Wind velocity may be taken as zero. Take R= 287.14 J/kg K. Calculate the pressure, temperature and density of air at stagnation point on the nose of the plane. Take k=1.4 [5+5]

OR

11.a) Explain about the Area Velocity relationship for compressible flow.

b) A tank contains air at a temperature of 30^{0}C. Air flows from the tank in to atmosphere through a convergent nozzle. The diameter at the outlet of the nozzle is 25 mm. Assuming adiabatic flow, find the mass rate of flow of air through the nozzle when the pressure of air in tank is (i) 3.924 N/cm^2 (gauge), (ii) 33.354 N/cm^2 (gauge). Take k = 1.4, R = 287 J/kg K and atmospheric pressure = 10.104 N/cm^2 (abs). [5+5]

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