



Registration No:

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M.TECH

AR-19

M.TECH 1ST SEMESTER EXAMINATIONS NOV/DEC 2019

TE, MPCTE1020

ADVANCED FLUID MECHANICS

Time: 3 Hours

Max Marks : 70

The figures in the right hand margin indicate marks.

PART-A

(10 X 2=20 MARKS)

1. Answer the following questions.

- a) Why dynamic viscosity of gas increases with increase of temperature.
- b) Distinguish between stress tensor and strain rate tensor.
- c) What is free vorticity of flow.
- d) Write down the differential form of Euler equation.
- e) Explain the concept of boundary layer of a flowing of fluid.
- f) What is skin friction coefficient.
- g) Differentiate between wall turbulence and free turbulence.
- h) What is friction factor in a laminar flow.
- i) What do you mean by Heimez flow.
- j) Write down the velocity distribution equation of a fully developed flow in a circular pipe.

PART-B

(5 X 10=50 MARKS)

Answer any five questions from the following.

- 2. (a) A flow field is given by $V = x^2y \vec{i} + y^2z \vec{j} - (2xyz + yz^2) \vec{k}$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2,1,3)
- (b) Prove that the continuity equation in a three dimensional Cartesian coordinate is given by $\frac{\partial}{\partial t} \rho + \frac{\partial}{\partial x} (\rho u) + \frac{\partial}{\partial y} (\rho v) + \frac{\partial}{\partial z} (\rho w) = 0$
- 3. (a) For two dimensional flow $\phi = 3xy$ and $\psi = (3/2)(y^2 - x^2)$. Determine the velocity component at the points (1, 3) and (3,3). Also find the discharge passing between the streamlines passing through the points given above.
- (b) Derive pressure difference between two points in an in viscid flow field in a steady flow is $(dp/\rho) + (gdz) + (Vdv) = 0$
- 4. (a) For the velocity profile for laminar boundary layer flow is $\frac{u}{U} = 2(Y/\delta) - (Y/\delta)^2$. Find the thickness of boundary layer at the end of the plate and the drag force on one side of the plate having 1 met long 0.8 met wide placed in water flowing with a velocity of 150 mm per sec. Calculate the value of coefficient of drag. Assume $(\mu)_{\text{wat}} = 0.01$ poise
- (b) Difference between Free vortex and Forced vortex flow
- 5. (a) Find the velocity profile, coefficient of friction factor and average velocity for a fully developed laminar flow in between two parallel plates. States your assumption early.
- (b) The flow field of a given fluid given by $V = (xy) \vec{i} + (2yz) \vec{j} - (yz + Z^2) \vec{k}$ Determine whether the flow is rotational or Irrotational.
- 6. (a) Derive prandtl boundary layer equation for steady two dimensional incompressible flow. Explain the significance of prandtl boundary layer equation in comparison with Navier-Stokes equation.
- (b) Explain stress tensor and rate of deformation tensor.
- 7. (a) In a hydro dynamically rough pipe of diameter 30 cm having turbulent flow, the centerline velocity is 5 m/s and the local velocity at 15 cm from the pipe center is 2.5 m/s. Find the discharge and the height of the roughness projection.
- b) Explain Von-Karman velocity defect law.
- 8. Write short notes on
 - a) Oseens approximation for slow viscous flow
 - b) Prandtl's mixing length theory