(iv) Distinguish between drag over cylinder in laminar and turbulent flow.

(v) For the given flow over flat plate, the wall shear stress in turbulent zone is always greater than laminar zone.

(vi) Neumann boundary conditions are approximated in FDM. (5×2=10)

(b) State with reasons whether following statements are true or false (Any FIVE)

(i) A doublet is a special case of a source and sink pair when the source and sink coincide, while moving along the x-axis as a pair.

(ii) The two stagnation points for an ideal flow over a circular cylinder coincide when the circulation around the cylinder has a critical value.

(iii) Kinematic eddy viscosity is direct measure of transporting capacity of mixing process.

(iv) Velocity distribution in laminar sub layer is logarithmic.

(v) Frequency of vortex shedding in Karman Vortex street depends upon Reynolds number of flow.

(vi) The terms Pressure diagram and pressure prism are used synonymously. (5×2=10)

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M. Tech 1st Semester Examination

Advanced Fluid Mechanics

WRE-101

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Attempt All Questions.

(ii) Draw neat sketches wherever necessary.

(iii) Assume missing data suitably and mention them clearly.

(iv) Use of non-programmable calculator and IS Code is permitted.

1. Attempt any FOUR

(i) Differentiate between Euler and Lagrangian method of describing fluid motion.

(ii) In a 2-D flow, show that the discharge per unit time across a line joining two points is equal to the difference between the stream function between two points.

(iii) Explain Reynolds stresses in detail.

(iv) How does the formulation of N-S equations differ from the formulation of Euler's Equation?

(v) A two dimensional flow is described in the Lagrangian system as

$x = x_0 e^{-kt} + y_0(1 - e^{-2kt})$ and $y = y_0 e^{kt}$

Find (a) the equation of path line of the particle and (b) the velocity components in Eulerian system. (4×5=20)

2. (a) Explain the signification of each term of Navier stoke equation and also explain the difficulties in getting its exact solution. (6)

(b) Obtain an expression for the pressure drop in steady, incompressible laminar Couette flow such that shear stress at stationary plate is zero. (4)

(c) Attempt any TWO

(i) Derive the expression for combination of uniform flow, doublet and vortex. Also explain Magnus effect and Kutta-Joukowsky law.

(ii) Derive the expression for combination of source and uniform flow.

(iii) Explain the Prandtl mixing length theory for turbulent shear stress and derive the necessary expression for mixing length. (2×5=10)

3. (a) Derive the momentum integral equation for boundary layer using momentum principle. (8)

(b) Attempt any TWO

(i) Differentiate between drag over flat plate due to laminar and turbulent boundary layers and give the necessary modifications in the equations for drag when both the boundary layers are formed together.

(ii) Explain the causes, mechanism and characteristics of turbulent flow.

(iii) Explain the phenomena of boundary layer separation in case of expanding channel and discuss the causes, effects and controlling methods. (2×6=12)

4. (a) Differentiate among forward difference, central difference and backward difference schemes and discuss their applicability. (6)

OR

What are different errors associated with finite difference methods? Explain the order of errors of solving 2-D finite difference equation. (6)

(b) Attempt any Two:

(i) State the fundamental equations which governs the compressible flow and discuss the nondimensional parameters governing such flow.

(ii) Discuss the conditions for the development of normal shock and oblique shocks in compressible flow and derive the continuity, momentum and energy equations for normal shock wave.

(iii) Explain compressibility correction factor and its significance giving necessary mathematical derivation. (2×7=14)

5. (a) Explain any FIVE in brief:

(i) Why is turbulent type of flow more frequently encountered in practice than laminar flow?

(ii) How the measurement of flow will be affected if the flow direction in venturimeter is reversed?

(iii) Distinguish between Distribution of wall shear in laminar & turbulent boundary layers.