Total No. of Questions : 8]

SEAT No. :

P3770

[Total No. of Pages :2

[4760] - 76
M.E. (Civil W.R.E.E.)
ADVANCED FLUID MECHANICS
(2012 Pattern) (Semester - I)

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

Instructions to the candidates:

1) ***Answer any three questions from each section.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables, slide rule, and non-programmable calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Derive three-dimensional form of equation of continuity in cylindrical co-ordinates. **[8]**

b) Define two-dimensional source and sink. Derive the expressions for velocity potential function and stream function for source and sink in rectangular and polar co-ordinate system. Sketch the patterns of equipotential lines and streamlines. **[8]**

Q2) a) Obtain the general form of Navier-stokes' equations. **[10]**

b) Starting from Navier-Stokes' equations, or otherwise derive the general equation of velocity distribution for steady incompressible laminar flow between fixed parallel surfaces. **[8]**

Q3) a) Derive Von Karman's momentum equation in integral form, for boundary layer as $\frac{d\theta *}{dx}=\frac{\tau_0}{\rho u^2}$. Notations have usual meanings. **[10]**

b) Assuming one-seventh power law velocity distribution for turbulent boundary layer, obtain the expressions for displacement thickness, momentum thickness and energy thickness in terms of nominal thickness. **[6]**

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Q4) Write short notes on: **[16]**

a) Boundary layer separation and its control.

b) Conformal mapping.

c) Doublet.

d) Cauchy-Reimann conditions.

SECTION - II

Q5) a) Distinguish between isotropic & homogeneous turbulence. **[6]**

b) Explain Prandtl's mixing length hypothesis. **[6]**

c) Explain probability density function. **[4]**

Q6) a) Explain the statistical theory of turbulence. **[6]**

b) For turbulent flow in a circular pipe of diameter 280 mm, the centreline velocity is 1.65 m/sec, and the point velocity at a radial distance of 70 mm is 1.5 m/sec. Calculate the discharge flowing through the pipe. Also calculate the friction factor and average height of roughness protrusions in the pipe. **[10]**

Q7) a) Derive the fundamental equation for velocity of propagation of compression pressure vave in an elastic medium. How will you modify this equation for gas flow under isothermal and frictionless adiabatic conditions? **[10]**

b) Conditions immediately upstream of a compression shock wave in an air flow are : $p_u = 34.2$ kN/m^2 (abs); $T_u = 0$ºC; $r_u = 1045$ m/sec.

Calculate the conditions immediately downstream of the shock wave. **[8]**

Q8) Write short notes on: **[16]**

a) Characteristics of turbulent flow.

b) Moody's diagram.

c) Mach Angle and Mach Cone.

d) Pitot sphere.