Total No. of Questions : 8]

SEAT No. :

P4224

[Total No. of Pages : 3

[4860]-603
M.E. (Civil) (WREE)
ADVANCED FLUID MECHANICS
(2012 Course) (Semester - I)

Time : 3 Hours] *[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 side indicate full marks.***
5) ***Use of logarithmic tables, slide rule, and non - programmable electronic pocket calculator is allowed.***
6) ***Assume suitable data, if necessary and state it.***

SECTION-I

Q1) a) Derive the most general form of equation of continuity in three dimensional cartesian co-ordinate system. **[9]**

b) A flow pattern is developed by combining uniform flow of velocity U m/sec, a source of flow rate of 10π m^3/sec/m and a sink of flow rate of 5π m^3/sec/m located at 4 m downstream from the source. Calculate the magnitude of U if the stagnation point is located 2 m upstream from the source. Also calculate the width of the stream surface enclosing the excess discharge from the source. **[9]**

Q2) a) In what respects are Navier Stokes' equations different from Euler's equations both for three dimensional flow in cartesian co-ordinate system? Starting from Euler's equations of motion derive Navier-Stokes' equations. **[8]**

b) Starting from Navier-Stokes' equations or otherwise, show that for laminar flow in a circular pipe, the velocity distribution is parabolic. **[8]**

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Q3) a) Derive Von Karman's momentum integral equation for boundary layer flow under the condition of zero pressure gradient. **[8]**

b) What is the general form of velocity distribution equation for laminar boundary layer flow as suggested by Karman and Pohlhausen. Explain the essential and desirable boundary conditions which must be satisfied by the assumed velocity distribution equation.

Check the validity of the velocity distribution equation. $\frac{u}{U} = 2\frac{y}{\delta} - 2\frac{y^3}{\delta^3} + \frac{y^4}{\delta^4}$ in the light of these boundary conditions. **[8]**

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

a) Flow net.

b) Solution of Laplace equation by relaxation method.

c) Simple couette flow.

d) Turbulent boundary layer.

SECTION-II

Q5) a) Explain the statistical theory of turbulence. **[6]**

b) Distinguish between isotropic turbulence and homogeneous turbulence. **[6]**

c) Explain probability density function. **[6]**

Q6) a) State and explain the various semi-empirical theories developed to determine the magnitude of shear stresses in turbulent flow. **[8]**

b) A rough pipeline of diameter 150 mm carries water at the rate of 112.5 litres per second. If the average height of roughness protrusions on the inner surface of the pipe is 0.15 mm, calculate the friction factor, maximum velocity, shear stress at the pipe surface and shear velocity. Take the kinematic viscosity as 1×10^{-6} m^2/sec and mass density as 1000 kg/m^3 for water at 20°C. **[8]**

Q7) a) Show that celerity of a sound wave in a fluid medium is given by $C = \sqrt{\frac{dp}{d\rho}}$. Hence show that (i) for a perfect gas, $C = \sqrt{KRT}$ and (ii) for a liquid $C = \sqrt{\frac{k}{\rho}}$. Notations have usual meanings. **[10]**

b) Calculate the pressure on the nose of a modern aeroplane moving at a speed of 900 kmph through still air. Also calculate the mach number. Take the atmospheric pressure and air temperature as 69.5 kN/m^2 and -2ºC respectively and mass density of air as 1.29 kg/m^3. **[6]**

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

a) Mechanism of turbulence.

b) Moody's diagram.

c) Pitot sphere.

d) Normal shock wave.