M. TECH.-I (CIVIL-HYDRAULIC ENGINEERING) (CBCS – 2015 COURSE) : WINTER - 2017

SUBJECT : ADVANCED FLUID MECHANICS

Day : **Monday** Time : **11.00 AM TO 02.00 PM**

Date : **15/01/2018** **W-2017-2772** Max. Marks : 60

N. B. :

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Answers to both sections should be written in the **SEPARATE** answer books.
4) Use of non-programmable calculator is **ALLOWED**.
5) Draw neat and labelled diagram **WHEREVER** necessary.
6) Assume suitable data, if necessary.

SECTION – I

Q. 1 Derive the continuity equation for three dimensional flow in Cartesian coordinates and deduce the continuity equation for two dimension flow. **(10)**

OR

a) Define stream line. Derive equation of stream line. **(05)**

b) The vorticity components of flow are given by: $u = -x$, $v = 2y$ *and* $w = 5 - z$. Find the equation of a stream line passing through a point (2, 1, 1). **(05)**

Q. 2 **a)** Discuss uses and limitations of flownet. **(05)**

b) If $\phi = x^2 - y^2$, find the expression for the components of velocity in x and y direction. Also find stream function ψ. **(05)**

OR

a) What is flow net? Describe any one method of drawing the flow net. **(05)**

b) If $\phi = 3xy$, find velocity components and stream function ψ. **(05)**

Q. 3 Obtain Bernoulli's equation from Euler's equation of motion along a stream line. List the assumptions involved. **(10)**

OR

A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively while the datum head A and B are 28 m and 30 m. Find the loss of head between A and B. **(10)**

SECTION – II

Q. 4 **a)** Derive an expression for velocity distribution for viscous flow through a circular pipe. Also sketch the distribution of velocity and shear stress across a section of pipe. **(05)**

P. T. O.

b) If a laminar flow in pipe $\Delta P = \frac{32\ \mu\ UL}{D^2}$, obtain expression for friction factor f. **(05)**

OR

a) Explain a method of determining viscosity of a liquid. **(05)**

b) Starting form Navier – Stokes equations in Cartesian coordinate system, show that for creeping flow, pressure satisfies Laplace equation. **(05)**

Q. 5 What is boundary layer? Draw a neat sketch of boundary layer on a flat plate and give equations for $\frac{\delta}{x}$, c_f *and* C_f in different regions. **(10)**

OR

a) Explain boundary layer separation with neat sketch. **(05)**

b) Explain with sketches: **(05)**

i) Laminar sublayer
ii) Hydrodynamically smooth boundary
iii) Hydrodynamically rough boundary.

Q. 6 **a)** Explain Prandtl's mixing length hypothesis. **(05)**

b) Derive the expression for velocity distribution near hydrodynamically smooth and rough boundaries in case of turbulent flow. **(05)**

OR

a) Explain the terms: **(05)**

i) Turbulence
ii) Intensity of turbulence
iii) Scale of turbulence

b) Describe characteristics of turbulence. **(05)**

* * * * *