M. Tech.-I (Civil-Hydraulic Engineering) (CBCS – 2015 Course) : WINTER - 2018

SUBJECT : ADVANCED FLUID MECHANICS

Day : Monday
Date : 03/12/2018

Time : 11.00 AM TO 02.00 PM
Max. Marks : 60

W-2018-3104

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 cylindrical and polar coordinates. **(10)**

OR

a) What is flow net? State uses of flownet. **(05)**

b) If $u = yz + t$, $v = xz - t$ and $w = xy$, determine the acceleration components a_x, a_y and a_z. **(05)**

Q. 2 a) Define rotation and vorticity. Prove that potential flow is also irrotational flow. **(05)**

b) If $u = x^2 + y^2 + z^2$ and $v = -xy - yz - xz$, determine the third components w of incompressible fluid flow. **(05)**

OR

Define velocity potential, stream function and flownet. Describe relaxation method for drawing flownet **(10)**

Q. 3 a) Starting from Euler's equations of motion along a stream line, obtain Bernoulli's equation. List the assumptions involved. **(05)**

b) The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end at the rate of 50 liter/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2 **(05)**

OR

a) Explain the terms energy correction factor and momentum correction factor. **(05)**

b) Describe a practical application of Bernaulli's equation. **(05)**

P. T. O.

SECTION – II

Q. 4 **a)** Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(05)**

b) Describe Helleshaw motion and show that it gives irrotational flow pattern. **(05)**

OR

a) Show that for steady uniform two-dimensional flow of real fluid $\frac{\partial p}{\partial x} = \frac{\partial \tau}{\partial y}$. **(05)**

b) Give dynamic and kinematic interpretation of Froude number and Reynold number **(05)**

Q. 5 Derive Von-Karman's momentum integral equation. State the assumptions made in the derivation. **(10)**

OR

Explain the concepts of boundary layer, nominal thickness, displacement thickness and laminar sublayer. **(10)**

Q. 6 Starting from Navier-Stokes equations in Cartesian coordinate system, derive Reynolds equations. **(10)**

OR

a) Explain Reynold's rules of averages. **(05)**

b) Prove that the time averaged velocity components satisfy the continuity equation. **(05)**

* * * * *