M. TECH.-I (CIVIL-HYDRAULIC ENGINEERING) (CBCS – 2015 COURSE) : SUMMER - 2018

SUBJECT : ADVANCED FLUID MECHANICS

Day : **Monday** **S-2018-2966** Time : **11.00 AM TO 02.00 PM**
Date : **28/05/2018** 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 expressions for tangential and normal accelerations. **(10)**

OR

If $u = yz + t$, $v = xz - t$ and $w = xy$, **(10)**
determine the acceleration components a_x, a_y and a_z
and resultant acceleration

Q. 2 **a)** Define velocity potential and stream function. Prove that stream lines and equipotential lines intersect orthogonally. **(05)**

b) State limitations of flownet. **(05)**

OR

a) Describe relaxation method for drawing flownet. **(05)**

b) A stream function is $\psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential. **(05)**

Q. 3 Derive Bernoulli's equation from 3 – D Euler's equations. State the assumptions involved. **(10)**

OR

Explain the term average velocity and derive expression for the energy and momentum correction factors. **(10)**

SECTION – II

Q. 4 **a)** Write Navier – Stokes equation for incompressible flow. Explain each term in those equations. What boundary conditions are required to be satisfied? **(05)**

b) If pressure loss ΔP in a circular pipe of diameter D depends on Length L, mass density ρ , velocity V, viscosity μ and pipe roughness k, perform dimensional analysis. **(05)**

P. T. O.

OR

a) How are the repeating variable chosen in dimensional analysis? **(05)**

b) The drag force F on a body of diameter D depends on viscosity μ, mass density ρ, volume modulus of elasticity E and its velocity U. Perform dimensional analysis. **(05)**

Q. 5 Explain with sketches the terms: **(10)**

i) Boundary layer

ii) Laminar boundary layer

iii) Turbulent boundary layer

iv) Laminar sub layer

OR

For the velocity distribution $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{1/7}$ in a boundary layer, determine the values of displacement thickness δ^*, momentum thickness θ, energy thickness δ^{**}. **(10)**

Q. 6 **a)** Describe characteristics of turbulence. **(05)**

b) Explain Reynolds rules of averages. **(05)**

OR

a) Describe Prandtl's mixing length hypothesis. **(05)**

b) Derive the expression for velocity distribution in hydrodynamically rough pipe. **(05)**

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