Total Number of Pages: 01 **M.Tech**
WRPC101

1st Semester Back Examination 2017-18
Advanced Fluid Mechanics
BRANCH: WATER RESOURCE ENGG AND MANAGEMENT
Time: 3 Hours
Max Marks: 70
Q.CODE:B813
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2x10)**

a) When the *streamlines*, *streaklines* and *pathlines* coincide?
b) What is a *doublet*?
c) Define *momentum thickness*.
d) What do you mean by fully developed flow?
e) For the flow defined by stream function ψ= xy, determine the vorticity components.
f) Write down Navior- Stokes equations for steady, incompressible flow in rectangular Cartesian coordinate system.
g) Write the methods to control boundary layer separation.
h) What do you mean by geometric similarity?
i) Differentiate between undistorted models and distorted models.
j) Differentiate between *wall turbulence* and *free turbulence*.

Q2 **a)** Derive the integral form of continuity equation starting from the statement of law of conservation of mass for a control volume. **(5)**
b) Differentiate between the Eulerian and Lagrangian method of representing a fluid. **(5)**

Q3 **a)** Differentiate between control mass and control volume system. **(4)**
b) A stream function is given as $\psi = x^2 - y^2$. Determine whether the flow is rotational or irrotational. How much discharge is passing through the points (1,2) and (2,2). **(6)**

Q4 **a)** Explain uniform flow with source and sink. Obtain expression for stream and velocity potential function **(4)**
b) A source of strength 0.8 m^2/s located at (-1, 0) is combined with a sink of strength 1 m^2/s located at (1, 0). Find the velocity components at point (2, 1). **(6)**

Q5 **a)** Outline the procedure used in the Buckingham's π theorem of dimensional analysis. **(4)**
b) If the capillary rise h depends on specific weight w, surface tension σ of the fluid and radius of the tube r show by dimensional analysis that $h/r = f(\sigma/wr^2)$ **(6)**

Q6 **a)** A smooth flat plate with a sharp leading edge is placed at zero incidence in a free stream of water flowing at 3 m/s. Determine the distance from the leading edge where the transition from laminar to turbulent flow may commence. The viscosity of water is 1 centi poise. Calculate the boundary layer thickness at the transition point. **(5)**
b) State and explain Von- Karman momentum integral equation. **(5)**

Q7 **a)** In an experiment on turbulent flow, following velocity data were recorded at 1 s interval at a point. **(5)**

u (cm/s)	15	27	33	-3	9	21
v (cm/s)	4	-5	-3	12	7	9

Find $'\overline{u'v'}'$.
b) How would you distinguish between hydrodynamically smooth and rough boundaries? Give the expression for relation between friction factor and Reynolds number for laminar and turbulent flow. **(5)**

Q8 **Write short notes on any TWO of the following :** **(5 x 2)**

a) Reynolds Transport Theorem
b) Potential flow
c) Dispersion of pollutants in a fluid medium