B. TECH. SEM - III (MECHANICAL ENGG.) (2014 COURSE) (CBCS)
: WINTER - 2017

SUBJECT: FLUID MECHANICS

Day: **Wednesday** Time: **10.00 AM TO 01.00 PM**
Date: **17/01/2018** **W-2017-2048** Max Marks: 60

N.B:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use of non- programmable **CALCULATOR** is allowed.
4) Use of steam table is allowed.
5) Assume suitable data if necessary.

Q.1 **a)** Differentiate between the flowing types of \fluid flows: **(05)**
i) Compressible & incompressible flow
ii) Laminar & turbulent flow

b) Write a short note of flow nets. **(05)**

OR

Q.2 If $\phi = 3xy$, find x & y components of velocity at (1, 3) & (3, 3). Determine the discharge passing between stream lines passing through these points. **(10)**

Q.3 **a)** Derive an expression for "Hydrostatic Law" **(05)**

b) Define and explain **(05)**
i)Metacenter
ii)Metacentric height

OR

Q.4 A triangular plane or 1 m base & 1.5 m altitude is immersed in water. The plane of the plate is inclined at 30° with water surface while the base is parallel to and at a depth of 2 m from the water surface calculate: **(10)**
i) the total pressure on the plate
ii) The position of center of pressure

Q.5 **a)** What are the various forces acting on a fluid in motion? **(05)**
Resolving these forces & acceleration along x, y & z directions and using different assumptions, write:
i) Reynolds equations of motion
ii) Navier stoke's equations of motion
ii) Euler's equations of motion

b) Water flows at the rate of 0.015 m^3/s through a 100 mm diameter orifice used in a 200 mm pipe. What is the difference of pressure head between the upstream section & the vena contracta section? Take coefficient of contraction $C_c = 0.6$ & $C_v = 1.0$. **(05)**

OR

Q.6 A 2 m long conical tube is fixed vertically with its smaller end upwards. It carries liquid in downward direction. The flow velocities at the smaller & larger ends are 5 m/s & 2 m/s respectively. The pressure head at the smaller end is 2.5 m of liquid. If the loss of head in the tube is $\frac{0.35(v_1 - v_2)^2}{2g}$ (v_1 & v_2 being the velocities at the smaller & larger ends respectively). Determine the pressure head at the larger end. **(10)**

Q.7 Derive Hagem- Poiseuille equation & state the assumptions made. **(10)**

OR

Q.8 **a)** Distinguish between friction drag and pressure drag. Define coefficient of drag & lift also. **(05)**

b) Experiments were conducted in a wind tunnel at 50 km/h on a flat plate of size 2 m ×1 m. The specific weight of air is 11.28 N/m^3. The plate is kept at such an angle that the coefficient of lift & drag are 0.75 & 0.15 respectively. Determine the power exerted by the air stream on the plate. **(05)**

Q.9 **a)** What is syphon? Where it is used? Explain its operation with the help of a sketch. **(05)**

b) The discharge of water through a horizontal pipe is 0.25 m^3/s. Its diameter, which is 200 mm, suddenly enlarges to 400 m. If the intensity of pressure of water in the smaller pipe is 120 kN/m^2, determine: **(05)**

i) Loss of head due to sudden enlargement

ii)Intensity of pressure in the large pipe

iii)Power loss due to enlargement

OR

Q.10 A pumping plant forces water through a 600 mm diameter main, the friction head being 27 m. In order to reduce the power consumption, it is proposed to lay another main of appropriate diameter along the side of the existing one, so that the two pipes may work in parallel for the entire length & reduce the friction head to 9.6 m only. Find the diameter of the new main if with the exception of diameter, it is similar to the existing one in every respect. **(10)**

Q.11 **a)** Define boundary layer & explain the fundamental causes of its existence. Also explain the characteristics of laminar & turbulent boundary layers. **(05)**

b) Show that the power P developed in a water turbine can be expressed as: **(05)**

$$P = \rho N^3 D^5 \phi \left(\frac{D}{B}, \frac{\rho D^2 N}{\mu}, \frac{ND}{\sqrt{gH}} \right)$$

ρ = Mass density of the liquid

N = speed in rpm

D = Diameter of the runner

B = width of the runner &

μ = co-efficient of dynamic viscosity.

OR

Q.12 **a)** Define and explain the significance of flowing non- dimensional parameters: **(05)**

i) Reynolds number

ii) Froude number

iii) Mach number

b) A plate 450 mm × 150 mm has been placed longitudinally in a stream of crude oil (specific gravity 0.925 & kinematic viscosity of 0.9 stoke) which flows with velocity of 6 m/s. Calculate: **(05)**

i)The friction drag on the plate

ii) Thickness of the boundary layer at the trailing edge.