B. TECH. SEM - III (MECHANICAL ENGG.) (2014 COURSE)
(CBCS) : SUMMER - 2018
SUBJECT: FLUID MECHANICS

Day: **Wednesday** | **S-2018-2256** | Time: **02.30 PM TO 05.30 PM**
Date: **23/05/2018** | 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) Laminar & turbulent flow
ii) Rotational & irrotational flow

b) Explain velocity potential & stream function. Also give relationship between them. **(05)**

OR

Q.2 In the two-dimensional incompressible flow field the velocity components are expressed as: **(10)**

$$u = 2x - x^2y + y^3/3 \qquad v = xy^2 - 2y - x^3/3$$

i) Determine the velocity & acceleration at point L (1, 3).
ii) Is the flow possible? If so, obtain the expression for the stream function
iii) If the flow irrational? If so, determine the corresponding velocity potential.

Q.3 **a)** Derive an expression for Pascal's law. **(05)**

b) Explain briefly the following types of equilibrium of flowing bodies: **(05)**
Stable equilibrium
Unstable equilibrium
Neutral equilibrium

OR

Q.4 A cylinder having 3 m diameter & 1.5 m length is resting on the floor. On one side, water is filled up to half the depth while on the other side oil of relative density 0.8 is filled up to the top. If the weight of the cylinder is 33.75 kN, determine the magnitudes of the horizontal & vertical components of the force which will keep the cylinder just touching the floor. **(10)**

Q.5 **a)** With the help of a neat sketch explain operation of venturimeter. Also state the relationships for horizontal as well as incline venturimeters with a tube manometer. **(05)**

b) The diameter of a tapering pipe at the sections 1-1 and 2-2 are 100 mm & 150 mm respectively. If the velocity of water flowing through the pipe at section 1-1 is 1.5 m/s find the velocity of water at section 2-2. **(05)**

OR

Q.6 Derive an expression for Euler's equation of motion in cartension coordinates. From this equation, also obtain the expression for Bernoulli's equation applicable for steady, irrotional flow of incompressible & fluids. **(10)**

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Q.7 For flow of viscous fluid between two fixed parallel plates, derive expressions for the following: **(10)**

i) Discharge through the plates
ii) Average velocity of flow
iii) Shear stress distribution

OR

Q.8 **a)** Distinguish between form drag and surface drag. **(05)**
Sketch roughly the flow patterns and state the relative magnitudes of these drags for a cylinder

b) An aero plane weighing 39.24 kN is flying in a horizontal direction at 360 km/h. The plane spans 15 m, and has a wing surface area of 35 m^2. If coefficient of drag $C_d = 0.03$ & for air $\rho = 1.22$ kg/m^3. Determine coefficient of lift & power required to drive the plane. **(05)**

Q.9 **a)** Derive an expression for the power transmission through the pipes. Find also the condition for maximum transmission of power & corresponding efficiency or transmission. **(05)**

b) Water is flowing through a pipe of diameter 200 mm with a velocity of 3m/s. If the coefficient of friction is given by $f = 0.002 + (0.9/Re^{0.3})$ where Re is Reynolds number, find the head loss due to friction for a length of 5 m. Take kinematic viscosity or water = 0.01 stoke. **(05)**

OR

Q.10 **a)** Derive Darcy- Weisbach formula for calculating loss of head due to friction in pipe. **(05)**

b) Three pipes of diameter 300 mm, 200 mm & 400 mm & lengths 300 m, 170 m & 210 m respectively are connected in series. The difference in water surface levels in two tanks is 12 m. Determine the rate of flow if co-efficient or frictions are 0.005, 0.0052 & 0.0048 respectively, neglecting minor losses. **(05)**

Q.11 **a)** With the help of neat sketch , explain the concept of development of boundary layer on a flat plate **(05)**

b) Define the following dimensionless numbers & state their significance for fluid flow problems: **(05)**

i) Reynolds number ii) Froude number iii) Mach number

OR

Q.12 **a)** For the velocity profile in laminar boundary layer as **(05)**

$$\frac{u}{U} = \frac{3}{2}\left(\frac{y}{8}\right) - \frac{1}{2}\left(\frac{y}{8}\right)^3$$

Find the thickness of the boundary layer & the shear stress 1.5 m from the leading edge of a plate. The plate is 2 m long & 1.4 m wide & is placed in water which is moving with a velocity of 200 mm per second.

b) What is model analysis? What are advantages & applications of model testing? **(05)**

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