BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - III MECHANICAL : : SUMMER - 2022
SUBJECT : MECHANICS OF FLUIDS

Day : Wednesday
Date : 01-06-2022

S-24489-2022

Time : 02:30 PM-05:30 PM
Max. Marks : 60

N. B. :

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

Q.1 **a)** With the help of a plot of velocity gradient $\left(\frac{du}{dy}\right)$ versus shear stress (τ) give classification of different types of fluids. **(05)**

b) A tank contains water up to a height of 0.5 m above the base. An immiscible liquid of sp.gr.0.8 filled on the top of water up to 1m height. Calculate : **(05)**
i. Total pressure on one side of the tank
ii. Position of center of pressure for one side of the tank, which is 2 m wide.

OR

a) If the velocity distribution over a plate is given by $u=\frac{2}{3}y-y^2$ in which u is the velocity in meter per second at a distance y meter above the plate, determine the shear stress at $y = 0$ and $y = 0.15$ m. Take dynamic viscosity of fluid as 8.63 Poise. **(05)**

b) What do you understand by hydrostatic law? Derive an expression for the same. What is Pascal's law? Give its applications. **(05)**

Q.2 **a)** How will you differentiate between stream function and velocity potential? **(05)**

b) The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation. **(05)**

i) $u=x^2+y^2+z^2$;
$v=xy^2-yz^2+xy$

ii) $v=2y^2, w=2xyz$

OR

a) Derive an expression for three dimensional form of continuity equation in Cartesian coordinates. Give its physical significance. **(05)**

b) In a two-dimensional incompressible flow, the fluid velocity components are given by $u=x-4y$ and $v=-y-4x$ show that velocity potential exists and determine its form. **(05)**

Q.3 **a)** Derive an expression for Euler's equation of motion. What is principle of operation of orifice meter? **(05)**

b) A pipe, through which water is flowing it having diameters, 20 cm and 10 cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0 m/s. Find the velocity head at sections 1 and 2 and also rate of discharge. **(05)**

P.T.O.

OR

a) What are the various forces acting on a fluid in motion? According to Newton's 2nd law of motion, write down equations for them. Also reduce the equations for different conditions to get Reynold's equation, Navier-Stoke's equation and Euler's equation. **(05)**

b) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a positions B which is 4 meters at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and direction of flow. **(05)**

Q.4 a) For a laminar flow of fluid between two fixed parallel plates, show that velocity distribution is parabolic. **(05)**

b) What do you understand by lift and drag? With the help of neat sketch, explain the formation of lift and drag on an inclined surface. **(05)**

OR

a) For a fully developed laminar flow of fluid through a circular pipe, show that average velocity of flow is half that of maximum velocity at the center. **(05)**

b) What do you understand by CFD methodology? How is it performed? What are its advantages and limitations? **(05)**

Q.5 a) What are the different types of energy losses occur during flow of fluids through them? **(05)**

b) What are HGL and TEL? With the help of a neat sketch explain both for two reservoirs connected by inclined pipe. **(05)**

OR

a) What do you understand by Moody diagram? What is its use? **(05)**

b) Water is flowing through a pipe of diameter 200 mm with a velocity of 3 m/s. Find the head lost due to friction for a length of 5 m if the co-efficient of friction is given by $f = 0.02 + \frac{0.09}{R_r^{0.3x}}$ where R is Reynolds number. The kinematic viscosity of water = 0.01 stoke. **(05)**

Q.6 a) What is the meaning of displacement, momentum and energy thicknesses? **(05)**

b) Using Buckingham's $\pi -$ theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is co efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(05)**

OR

a) What is separation of boundary layer? Why is it not desirable? What are the methods to reduce it? **(05)**

b) Find the expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid. **(05)**

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