



SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code : Fluid Mechanics (18CE0104)

Course & Branch: B.Tech - CE

Year & Sem: II-B.Tech & I-Sem

Regulation: R18

UNIT –I

FLUID PROPERTIES AND STATICS

1. a) State Pascal's law. What do you understand the terms Absolute, Gauge, atmospheric & vacuum pressure? 5M
- b) What is the gauge pressure at a point 3m below the free surface of a liquid having a density $1.53 \times 10^3 \text{ kg/m}^3$. If the atmospheric pressure is equivalent to 750mm of mercury? The Specific gravity of mercury is 13.6 and density of water = 1000 kg/m^3 5M
2. Define Manometer. Briefly explain the types of manometers in detail? 10M
3. a) A simple U – tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm 5M
- b) A hydraulic pipe has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500N?
4. a) An inverted U – tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30cm. When an oil of specific gravity 0.8 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted manometer (when measured from the respective centre lines of the pipes) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. 5M
- b) Derive expression for surface tension on liquid droplet and soap bubble? 5M
5. Derive expressions for the total pressure and centre of pressure for an inclined plane surface submerged in the liquid. 10M
6. Explain how you would find the resultant pressure on a curved surface immersed in the liquid. 10M
7. Define centre of pressure and derive an expression for centre of pressure for a vertically submerged surface. 10M
8. a) Write short notes on viscosity, kinematic viscosity and Newton's law of viscosity? 5M
- b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 2.5mm. The upper plate which moves at 2.5 m/sec requires a force of 9.81N to maintain the speed. Determine dynamic viscosity of the oil in poise and kinematic viscosity of oil if specific gravity of oil is 0.95
9. a) Explain the pressure variation in a fluid at rest? 5M
- b) Define specific density and specific weight, viscosity, vapour pressure and cavitation? 5M

- 10.a) A rectangular plane surface 3 m wide and 4 m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure force and position of centre of pressure, when the upper edge is 2 m below the free surface. 5M
- b) Find the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 4 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 8 m. 5M

UNIT –II

FLUID KINEMATICS

1. a) Define stream line, streak line and path line, stream tube and control volume? 5M
- b) Write a brief note on continuity equation for a one- dimensional flow? 5M
2. Obtain an expression for continuity equation for a three - dimensional flow. 10M
3. a) The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4, 5). 5M
- b) A stream function is given by $\psi = 5x - 6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point.
4. show that the product of equi- streamline and equi- potential line is “ -1” ? and define flow net, equi-potential line , equi -stream lines ? 10M
5. The velocity vector in a fluid flow is given by $V=4x+10xy+2k$ find the velocity and acceleration at fluid particle (2,1,3) & $t=1$ 10M
- 6 a) If for a two – dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at the point p (4, 5). Determine also the value of stream function Ψ at the point p.
- b) The following case represent the two velocity components, determine the third velocity component such the they satisfy the continuity equation i) $u= x^2+y^2+z^2$, $v= xy^2-yz^2+xy$ and ii) $v=2y^2$, $w=2xyz$ 5M
8. a) What is the relation between stream function and velocity potential function? 5M
- b) Write a short notes on the following i) Equipotential line ii) Line of constant stream function iii) Flow net 5M
9. a) Define compressible and incompressible flows.
- b) Define laminar and turbulent flows.
- c) Define uniform and non uniform flow.
- d) Distinguish between rotational and irrotational flow.
- e) Distinguish between steady and unsteady flow 10M
10. The velocity vector in a fluid flow $V= 4x^3i-10x^2yj+2tk$, find the velocity and acceleration of a fluid particle at (2, 1, 3) at time $t=1$.

UNIT –III
FLUID DYNAMICS

1. a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive the expression for Bernoulli's theorem from first principle and state the assumption made for such a derivation. 5M
- b) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s. Find the discharge in the pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. 5M
2. Derive the expression for actual discharge in venturimeter? 10M
3. a) Find the expression for the Discharge over a Rectangular notch or weir 10M
- b) In a 100mm diameter horizontal pipe a venture meter of 0.5 contraction ratio has been fixed. The head of water on the meter when there is no flow in 3m (gauge). Find the rate of flow for which the throat pressure will be 2m of water is 0.97 take atmospheric pressure head = 10.3m of water. 5M
4. A horizontal venture meter with 30cm diameter inlet and 10cm throat is used for measuring the flow of water through a pipeline. If pressure in pipe is 1.5kpa and the vacuum pressure at the throat is 40cm of mercury, calculate the rate of flow. It may be presumed that 5% of differential head is lost between the pipe main and the throat section. Also make calculations for the discharge co-efficient take specific weight of water = 10kN/m³ 10M
5. What is Euler's equation of motion? How do you obtain Bernoulli's equation from it? Name the different forces present in a fluid flow 10M
6. a) What is flowing through a pipe of 5 cm diameter under a pressure of 29.43N/cm³ (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross section which is 5 m above the datum line. 5M
- b) Water is flowing through a pipe has diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm² and the pressure at the upper end is 9.81 N/cm². Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. 5M
7. An external cylindrical mouth piece of diameter 150 mm is discharging water under a constant head of 6 m. Determine the discharge and absolute pressure head of water at B vena – contract a. Take $C_d = 0.855$ and C_c for vena contract a = 0.62 and atmospheric pressure head = 10.3 of water. 10M
8. a) An oil of $S_g=0.8$ is flowing through a venturimeter having inlet diameter 20cm and throat dia 10cm . the oil – Hg differential manometer shows a reading of 25 cm . calculater discharge of oil through horizontal venturimeter? take $C_d =0.98$ 5M
- b) A horizontal venturimeter having inlet diameter 20cm and throat dia 10cm is used to measure the flow of oil having S_g 0.8 the discharge of oil through venturimeter is 60l/s. find the reading of the oil – Hg in differential manometer ? C_d is 0.98 5M
- 9 a) Define hydraulic gradient line and total energy line. 5M
- b) Explain briefly the analysis of free liquid jets. 5M

10. a) Explain Pitot tube with neat sketch ? 5M
 b) A sub-marine moves horizontally on a sea and has its axis 15m below the surface of water. A pitot tube properly placed just in front of a sub-marine and along its axis is connected to two limbs of a u – tube containing mercury. The difference of mercury level is found to be 170mm find the speed of the sub-marine knowing that the specific gravity of mercury is 13.6 and that of sea water is 1.026 with respect of fresh water 5m

UNIT –IV

FLOW THROUGH PIPES

1. Derive the expression for head loss in pipes due to friction by Darcy - Weisbach equation and chezy's formula 10M
2. a) Derive the expression for flow through pipes in series. 5M
 b) Derive the expression for flow through parallel pipes. 5M
3. Derive the expression for head loss in pipes due to sudden enlargement and sudden contraction formula 10M
4. The rate of flow of water through a horizontal pipe is $0.25\text{m}^3/\text{s}$. The diameter of the pipe which is 200 mm is suddenly enlarged to 400mm. The pressure intensity in the smaller pipe is $1.772\text{N}/\text{cm}^2$. Determine the i) Head loss due to sudden enlargement ii) Pressure intensity in the large pipe
 iii) Power lost due to enlargement 10M
5. A horizontal pipe of diameter 500mm is suddenly contracted to a diameter of 250mm. The pressure intensity in the larger and smaller pipe is given as $13.734\text{ N}/\text{cm}^2$ and $11.772\text{ N}/\text{cm}^2$ respectively. Find the head lost due to contraction if C_c is 0.63. Also determine the rate of flow of water? 10M
6. A Siphon of diameter 200 mm connects two reservoirs having a difference in elevation of 20 m. The length of the siphon is 500 m and the summit is 3.0 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to the summit is 100 m. Determine the discharge through the siphon and also pressure at the summit. Neglect minor losses. The coefficient of friction is 0.005. 10M
7. A horizontal pipe line 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300mm. the height of water level in the tank is 8m above the centre of the pipe line. Considering all losses of head which occur and determine the rate of flow take $f=0.01$ for both sections of pipe. 10M
8. The difference in water surface levels in two tanks which are connected by three pipes in series of lengths 300m, 170m and 210m and diameters of 300mm, 200mm and 400mm respectively is 4m. Determine the rate of flow of water if coefficients of friction are 0.005, 0.0052, 0.0048 respectively, considering i) minor losses ii) neglecting minor losses 10M
9. A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of same diameter is introduced parallel to the first in the second half of the length .Neglecting minor losses, find the increase in discharge if $4f = 0.04$. The head at inlet is 300 mm. 10
10. a) Find the head lost due to friction in a pipe of diameter 300 mm and the length 50 m, through which water is flowing at velocity of 3 m/s using i) Darcy formula ii) Chezy's formula for which $C=60$ and kinematic viscosity 0.01 stokes? 5M
 b) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 lit/s. 5M

UNIT –VLAMINAR FLOW TURBULENT FLOW

1. Derive the Expression for maximum velocity for a Laminar flow through circular pipes? 10M
2. An oil of viscosity 0.1 Pa.s and relative density 0.9 is flowing through a horizontal pipe of diameter 50mm. if the pressure drop per meter length of pipe is 12 Kpa, determine
 - a) Rate of flow in N/minute
 - b) Shear stress at pipe wall
 - c) Reynolds number of flow
 - d) Power required in W Per 50m length to maintain the flow 10M
3. Derive the equation for the flow of viscous fluid between two parallel plates? When plates are fixed 10M
4. An oil of dynamic viscosity 1.05 poise and relative density 0.92 is flowing through a fixed parallel plates kept 1.2cm apart if the Mean Velocity is 1.40m/s. calculate
 - a) The maximum velocity
 - b) Boundary shear stress
 - c) Velocity & shear stress at distance of 0.2 cm from plates
 - d) Headloss at $y=25m$ 10M
5. a) Explain the Reynolds's experiment with neat sketch 5M
 b) Define Reynolds's number and derive the expression for Reynolds's number? 5M
6. Explain the difference between turbulent flow and Laminar flow? explain the causes of turbulent flow 10M
7. An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300 m. The rate of flow of fluid through a circular pipe is 3.5 lit/sec. Find the pressure drop in a length of 300m and also the shear stress at the pipe wall? 10M
8. Mean point velocities measured with the help of a pitot tube at mid point and quarter point of a 0.2m dia pipe were found to be 1.50m/s and 1.35m/s respectively .if the flow in pipe is turbulent . Determine discharge, friction factor, and average height of roughness projections 10M
9. For a turbulent flow in a pipe diameter 300mm, find the discharge when center line velocity is 2m/s & velocity at a point 100mm from center is 1.6m/s? 10M
10. Explain briefly about Moody's diagram? 10M

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