IES COLLEGE OF ENGINEERING, CHITTILAPPILLY
DEPARTMENT OF CIVIL ENGINEERING

SEMESTER III- FLUID MECHANICS AND HYDRAUICS

MODULE 1

1. What is meant by buoyancy?
2. Describe different types of manometers with neat sketches.
3. A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of plate and position of centre of pressure.
4. Define the following properties and give their dimensions;
   i. Mass density
   ii. Specific weight
   iii. Specific gravity
   iv. Vapour pressure
   v. Capillarity
   vi. Viscosity
   vii. Compressibility
   viii. Surface tension
5. State Pascal's Law and Hydrostatic Law.
6. Define the centre of buoyancy and metacentre.
7. A U tube differential manometer connects two pipes A and B. Pipe A contains carbon tetra chloride having a specific gravity 1.594 under a pressure of 11.772 N/cm^2 and pipe B contain oil of specific gravity 0.8 under a pressure of 11.772 N/cm^2 . The pipe A lies 2.5 m above pipe B. Find the difference of pressure measured by mercury as fluid filling U tube.
8. What are the different conditions of equilibrium of floating and submerged body?
9. Two plates are placed at a distance of 0.15 mm apart. The lower plate is fixed while the upper plate having a surface area 1.0 m^2 is pulled at 0.3 m/s. Find the force and power required to maintain this speed, if the fluid separating them is having a viscosity of 1.5 poise.
10. Derive an expression for the depth of centre of pressure from the free surface of liquid of an inclined plane surface submerged in a liquid.
11. A solid cylinder of diameter 4.0 m has a height of 4.0 m Find the metacentric height of the cylinder if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable.

MODULE 2

1. What is meant by free vortex and forced vortex?
2. Define vorticity.
3. Write short notes on stream potential function and velocity potential function.
4. Sketch the stream line represented by $\Psi = x^2 + y^2$. Also find the velocity and its direction at point (1, 2).
5. Briefly discuss the stream lines, path lines and streak lines.
6. Differentiate between local and convective acceleration.

7. Define flow net. What are the uses of flow net?

8. The velocity components in a 2D flow field for an incompressible fluid are expressed as $u = y^3/3 + 2x - x^2y$; $v = xy^2 - 2y - x^3/3$. Show that these functions represents a possible case of an irrotational flow and obtain the expression for stream function and velocity potential function.
9. Explain the significance of Reynold's number.
10. Write notes on different types of flow.
11. What are the methods of describing fluid motion?
12. Derive the equation of continuity in three dimensions.

MODULE 3

1. 250 l/s of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bend by 135^0, find the magnitude and direction of resultant force on the bend. The pressure of water flowing is 39.24 N/cm^2.
2. A venturimeter 150 mm x 75 mm is installed in a horizontal pipe line of 150 mm diameter carrying oil(S = 0.9). The mercury level difference in the U tube manometer connected to inlet and throat is 175 mm. If $C_d = 0.97$, find the rate of flow through the pipe.
3. State Bernoulli's theorem and what are the assumptions?
4. Derive Bernoulli's equation.
5. What are the applications of Bernoulli's theorem? Explain each of them.
6. The inlet and throat diameters of a horizontal venturi meter are 0 cm and 10 cm respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is 13.74 N/cm^2 while the vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. Assume that 4% of the differential head is lost between the inlet and throat. Find also the value of C_d.
7. What are the advantages of venturi meter over orifice meter? Explain with a neat sketch.
8. State the momentum equation? How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend?
9. A pitot tube is inserted in a pipe of 300 mm diameter. The static pressure in pipe is 100 mm of mercury (vacuum). The stagnation pressure at the centre of the pipe, recorded by the pitot tube is 0.981 N/cm^2 . Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the central velocity. Take $C_v = 0.98$
10. Define the hydraulic coefficients of an orifice and derive the relationship between them.
11. A rectangular orifice of 2 m width and 1.2 m deep is fitted in one side of a large tank. The water level on one side of the orifice is 3 m above the top edge of the orifice, while on the other side of the orifice, the water level is 0.5m below its top edge. Calculate the discharge through the orifice if $C_d = 0.64$

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MODULE 4

1. What is meant by most efficient section of an open channel. Derive the condition for the most efficient rectangular section.
2. Sketch the velocity distribution pattern in open channels.
3. Derive Chezy's equation.
4. Find the bed slope of trapezoidal channel of bed width 6m, depth of flow of water 3m, and side slope 3H to 4V. when discharge through the channel is $30m^3$/sec. C=70
5. Explain the different geometric elements of channel section. Determine the elements for rectangular & trapezoidal channels.
   (10marks)
6. A trapezoidal channel section having side slope 3H to 2V is to carry a flow of 20m3/s with bed gradient 1 in 1000, the channel is to be lined for which the value of n =0.002. find the dimension of most economical channel section. Also find chezys constant of required section.
7. A trapezoidal channel having bottom slope of 0.0016, bottom width of 6m & side slope of 2H to 1V is laid. If it carries a uniform flow of water at the rate of 10m3/s. compute the normal depth & mean velocity of flow manning′s n=0.025. by algebraic & graphical method.
8. Define most economical/efficient section of a channel. Derive the equation for most economical trapezoidal channel section.
9. A trapezoidal channel having bottom slope of 0.0016, bottom width of 6m & side slope of 2H to 1V is laid. If it carries a uniform flow of water at the rate of 10m3/s. compute the normal depth & mean velocity of flow manning's n=0.025. by algebraic & graphical method.
10. A lined trapezoidal channel with manning′s n =0.014, is to carry 100m3/sec discharge with permissible velocity 2.5 m/s. If the side slopes of the channel are 1H:1V. Determine channel dimensions and slope if it is to be designed as most efficient.

MODULE 5

1. State the assumptions involved in the derivation of dynamic equation of gradually varied flow.
2. Sketch all the steep slope GVF profiles.
3. Explain the different classification of surface profiles.
4. Explain the step by step procedure for computing back water profile using step method.
5. Derive the expression for the length of Back Water Curve.
   (10 MARKS)
6. A very wide rectangular channel carries a discharge of $8m^3$/s per m width. The channel has a bed slope of 0.004 and the Manning's roughness coefficient of 0.015.

At a certain section, the flow depth is 1m. Compute the length of water surface profile to a section with flow depth of 0.9m. Use direct step method.

7. A rectangular channel; 10m wide bottom slope of 0.00016 and Manning's coefficient of .014 carries flow at a uniform depth of 2.0m. If the dam is constructed at its downstream end of such height that the depth immediately upstream of it is 12m, determine how far upstream the flow depth will be 2.5m. Classify the surface profile.
8. The depth of flow of water at a certain section of rectangular channel of 5m wide is 0.6m. the discharge through the channel is 15m3/s. if the hydraulic jump takes place on the down stream find the depth of flow after the jump & loss of energy per kg of water?.
9. Sluice gate discharge water into a horizontal rectangular channel with a velocity 6m/s & depth of flow is 0.4m. The width of channel is 8m. Determine whether the jump will occur, if so find the height & length of jump and energy loss per kg of water.
10. A rectangular channel which is laid on a bottom slope of 0.0064 is to carry 20m3/s of water. Determine the width of the channel when flow is in critical condition. Take manning′s n =0.015
11. Find the specific energy of flowing water through a rectangular channel of width 5m when the discharge is 15m3/s and depth of water 2.5m.
12. Show that the relation between minimum specific energy E_{min} and critical depth y_c for a rectangular channel can be expressed as $E_{min}=1.5\ y_c$.

FACULTY IN CHARGE
SHAMNA ABDULLA