Fluid Mechanics & Hydraulics (3140611)

IMP QUESTIONS

Module 1 – Properties of fluids

1. Define the terms:
   a) Kinematic Viscosity
   b) Specific Gravity
   c) Specific Weight
   d) Ideal Fluid
   e) Newtonian Fluid
   f) Compressibility and Bulk modulus
   g) Newton's law of viscosity
2. Explain the capillary action of rise and fall of liquid columns.
3. Define Surface tension. Derive an expression of surface tension for liquid droplet and hollow bubble.

Module 2 – Fluid Statics

1. State Pascal's law of pressure and prove it.
2. Explain Hydrostatic paradox.
3. Write a short note on (i) Piezometer (ii) Inverted U-tube differential manometer
4. Define different types of pressure with help of chart.
5. Explain construction and working of vertical and inclined single column manometer with equation.
6. Explain construction and working of bourdon tube pressure gauge with neat sketch.
7. Define total pressure and centre of pressure also derive an expression for total force and centre of pressure on a vertical plane surface submerged in static liquid.
8. Derive expressions for total force and centre of pressure on an inclined plane surface submerged in static liquid.
9. Discuss the equilibrium conditions for floating and submerged bodies with proper sketches.
10. Define metacentric height and derive theoretical equation for the metacentric height of a floating body.
11. Examples

Module 3 – Fluid Kinematics and Dynamics

1. Discuss about types of fluid flow.
2. Derive continuity equation for three dimensional incompressible flow.

3. Define following terms
   i) Path line, ii) streamline, iii) streak line
4. Derive Bernoulli's equation from Euler's equation of motion. State assumptions also.
5. Derive Euler's equation of motion along streamline.

Module 4 – Flow Measuring Device

1. Derive equation for rate of flow through the venturimeter.
2. Derive equation for discharge over a rectangular weir/Triangular weir.
3. Derive the equation for determining the discharge from Borda's mouthpiece running full.
4. Define various hydraulic coefficients. How to determine coefficient of velocity experimentally?
5. What is Pitot tube? Derive equation of velocity for flow of fluid through it.
6. What are the advantages of triangular notch over a rectangular notch?
7. Classify various types of notches.
8. Examples

Module 5 – Flow through pipes

1. Derive Darcy Weisbach formula for the loss of head due to friction in pipe line.
2. Derive an expression for the loss of head due to sudden enlargement of a pipe.
3. Enlist the major and minor loses in pipes. Derive the expression for loss of head due to sudden contraction.
4. Explain the terms: Pipes in parallel and Equivalent pipe.
5. Explain hydraulically smooth and rough pipes
6. Derive the Hagen-Poiseuille equation and state the assumptions made.
7. Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature.
8. Enlist the important applications of Navier-stoke equations
9. Define (i) Cavitation (ii) Prandtl Mixing length (iii) Water Hammer (iv)) Total energy line (v) Hydraulic gradient line
10. What is couette flow? Derive an expression of velocity and shear stress for couette flow.
11. Examples based on above theories.

Module 6– Open Channel Flow

1. Prove that for trapezoidal channel of most economical section half of top width is equal to length of one of the sloping side.
2. Define: Critical flow, Critical depth, Alternate depth, Subcritical flow. Draw the specific energy curve for constant discharge in an open channel.
3. Define the most economical channel section and Discuss the importance of it.
4. Explain in brief types of flow in open channel.

5. Derive the equation for gradually varied flow. Discuss the assumptions made for the derivation.
6. Derive the Chezy's and Manning's formula in case of open channel flow.
7. Write the assumptions made in derivation of the Dynamic Equation of the Gradually varied flow.
8. Examples

Module 7 – Dimensional Analysis and Similitude

1. Explain Froude model law. Obtain scale ratio for time, acceleration and discharge for the Froude model law.
2. Explain the Buckingham's π-theorem in dimensional analysis.
3. Explain the various types of similarities exist between model and its prototype.
4. Prove that the resistance F of sphere of diameter d moving at a constant speed v through a fluid of density ρ and dynamic viscosity μ may be expressed as

$$F = \frac{\mu^2}{\rho}\,\phi\left(\frac{vd\rho}{\mu}\right)$$

5. Example similar to Example 5.