MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

Department of Mechatronics Engineeering
Question Bank - Academic Year (2020-21)

Course Code & Course Name : 19MZC02 & Fluid Mechanics and Machinery

Year/Sem : II / III

Unit-I: Fluid Properties and Flow Characteristics

Part-A (2 Marks)

1. State Newton's law of viscosity.
2. Define Kinematic viscosity.
3. Name the different Types of fluids.
4. What is Compressibility?
5. Write the continuity equation.
6. List the types of fluid flow.
7. Define Uniform and Non-uniform flow.
8. Compare Laminar and Turbulent flow.
9. Short notes on Compressible and incompressible flow
10. State the assumptions used in deriving Bernoulli's equation

Part-B (16 Marks)

1. (i).The space between the two square parallel plates is filled with oil. Each side of the plate is 60cm. the thickness of the oil film is 12.5mm. The upper plate which moves at 2.5m/s requires of force of 98.1N maintaining the speed. Determine (i) the dynamic viscosity of oil in poise. (ii) The kinematics viscosity of oil in stokes if the specific gravity of oil is .95. (8)

   (ii)A plate .025mm distance from a fixed plate moves at 60 cm/s and requires a force of 2N per unit area i.e. 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates. (8)

2. Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerin. What force is required to drag the very thin plate of surface area 0.5m^2 between the two large plane surfaces at a speed of 0.6m/s, if, (i) the thin plate is in the middle of the two plane surfaces, and (ii) the thin plate is at a distance of 0.8 cm from one of the plane surfaces? Take the dynamic viscosity of glycerin = $8.10\times10^{-1}s/m^2$ (16)
3. Derive the expression for Bernoulli's equation from Euler's equation along with assumptions (16)
4. (i). Derive the expression for continuity equation (8)

   (ii). A 30cm diameter pipe conveying water branches into two pipes of diameter 20cm and 15cm respectively. If the average velocity in the 30cm diameter pipe is 2.5m/s. find the discharge in this pipe. Also determine the velocity in 15cm pipe if the average (8)

velocity in 20cm diameter pipe is 2m/s

5. (i). Water is flowing through a pipe having diameters 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/Cm^2 and the pressure at the upper end is $9.81N/cm^2$. Determine the difference in datum head if the rate of flow through pipe is 40 lit/sec. (8)

(ii). Define compressibility, what is the bulk modulus of elasticity of a liquid which is compressed in a cylinder from a volume of $.0125m^3$ at N/cm^2 pressure to a volume of $.0124\ m^3$ at 150 N/cm^2 pressure. (8)

Unit-II : Flow Through Circular Conduits

Part-A (2 Marks)

1. Mention the range of Reynold's number for laminar and turbulent flow in a pipe.
2. Give the expression for the coefficient of friction in viscous flow?
3. State Darcy-Weisbach equation
4. Classification of boundary layer.
5. Define Boundary layer Thickness.
6. List the various types of boundary layer thickness.
7. What are the factors influencing the frictional loss in pipe flow?
8. Write the expression for loss of head due to sudden enlargement of the pipe.
9. What is meant by Moody's chart and what are the uses of Moody's chart?
10. Define the terms a) Hydraulic gradient line [HGL] b) Total Energy line [TEL]

Part-B (16 Marks)

1. (i). Derive an expression for Darcy-weisback formula. (8)

   (ii).A crude oil of kinematics viscosity 0.4 stokes is flowing through a pipe of diameter 300mm at the rate of 300 lit/sec. find the head lost due to friction for a length of 50m of the pipe. (8)
2. The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300m, 170m, and 210m and of diameters 300mm, 200mm and 400mm respectively, is 12m. Determine the rate of flow of water if the coefficients of friction are 0.005, 0.0052, and 0.0048 respectively. Considering minor losses and neglecting minor losses (16)
3. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of pipe. Considering all losses of head which occurs, determine the rate of flow. Take f = 0.01 for both sections of pipe.
4. A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000m and 1m respectively, while the length and diameter of second parallel pipe are 2000m and .8m. Find the rate of flow in each parallel pipe, if the total flow in the main is $3m^3/s$.The coefficient of friction for each parallel pipe is same and equal to .005 (16)
5. At a horizontal pipe of dia 500mm is suddenly contracted to a diameter of 250mm. the pressure intensities in the large and smaller pipe as 13.734 N/cm^2 &11.772 N/cm^2 respectively. Find the loss of head due to contraction if C_c=0.62. Also determine the rate of flow of water (16)

Unit-III : Dimensional Analysis

Part-A (2 Marks)

1. Write the uses of dimension analysis?
2. Define dimensional homogeneity.
3. Mention the methods available for dimensional analysis.
4. State Buckingham's π theorem.
5. List the repeating variables used in Buckingham π theorem.
6. Define model and prototype.
7. List the types of similarities or similitude used in model analysis.
8. Mention the various forces considered in fluid flow.
9. Define model law or similarity law.
10. State Reynold's model law

Part-B (16 Marks)

1. State and explain Buckingham's π Theorem. What are the considerations in the choice of repeating variables? (16)
2. The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ, and roughness k, using Buckingham's π-theorem, obtain an expression for Δp. (16)
3. Determine the dimensions of following quantity (i). Angular velocity (ii) Discharge (iii) Force (iv) Density (v) kinematic viscosity (16)
4. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends on the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, and elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. (16)
5. Define Euler's number, Weber's number, Mach's number with expressions (16)

Unit-IV : Pumps

Part-A (2 Marks)

1. What is roto dynamic pump?
2. Define Centrifugal pump.
3. Differentiate static head & manometric head.
4. Compare Centrifugal Pump & Reciprocating Pump.
5. What is priming of a centrifugal pump.
6. Short notes on reciprocating pump?
7. What is single acting pump and double acting pump?
8. Define slip and % slip.
9. What is the purpose of an air vessel fitted in the pump
10. Write the major parts of centrifugal pump

Part-B (16 Marks)

1. Explain the working principle of centrifugal pump with neat sketch and draw the velocity triangles of centrifugal pump. (16)
2. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000rpm, works against a total head of 40m. The velocity of flow through the impeller is constant and equal to 2.5m/s. the vanes are set back at an angle of 40˚at outlet. If the outer diameter of the impellor is 500mm and width of the outlet is 50mm, determine the vane angles at inlet, work done by the impeller on the water per second, manometric efficiency (16)
3. (i).Explain the working principle of single acting and double acting reciprocating pump with neat sketch (8)
   (ii).A single acting reciprocating pump running at 50 rpm, delivers $0.01m^3/s$ of water. The diameter of the piston is 200mm and stroke length 400mm. determine (i). the theoretical discharge of the pump, (ii). Co-efficient of discharge, (iii). Slip and the percentage of slip of the pump (8)
4. Explain about rotary pumps and its classifications. (16)
5. Describe about Manometric, Mechanical, Over all efficiencies of centrifugal pump (16)

Unit-V : Turbines

Part-A (2 Marks)

1. How fluid machines are classified?
2. What are called turbines?
3. Short notes on the efficiencies of a turbine?
4. What are an impulse turbine and a reaction turbine?
5. Define Jet Ratio.
6. Classify of hydraulic turbines
7. Define Radial flow reaction turbine and their types.
8. What is mean by Draft Tube?
9. Why do draft tubes have enlarging passage area in the direction of flow?
10. Define specific speed of a turbine.

Part-B (16 Marks)

1. Explain the working principle of any one turbine with neat sketch and draw the velocity triangles of Pelton turbine. (16)
2. A Pelton wheel is to be designed for the following specifications: shaft power= 11772kw; head=380 metres; speed=750rpm; over all efficiency=86%; jet diameter is not to exceed one sixth of wheel diameter. Determine the wheel diameter, the number of jets required, and diameter of the jet. Take k_{v1}=.985 and k_{v2} = .45 (16)
3. A Kaplan turbine working under a head of 20m develops 11772kw shaft power. The outer diameter of the runner is 3.5m and hub diameter 1.75m. The guide blade angle at extreme edge of the runner is 35˚. The hydraulic and over all efficiency of the turbines is 88% and 84% respectively. If the velocity of whirl is zero at outlet, determine the runner vane angles at inlet and outlet at the extreme edge of the runner, and speed of the turbine. (16)
4. Define specific speed of the turbine. Describe about governing of turbines. (16)

5. A Francis turbine with an overall efficiency of 75% is required to produce 140.25KW power. It is working under a head of 7.62m. The peripheral velocity = $0.26x\sqrt{(2gH)}$ and the radial velocity of flow at inlet is $0.96x\sqrt{(2gH)}$. The wheels run at 150r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, Determine, (i) The guide blade angle, (ii) The wheel vane angle at inlet, (iii) Diameter of the inlet at inlet, and (iv) Width of the wheel at inlet (16)