UNIT-1 INTRODUCTION

SYLLABUS

INTRODUCTION 12

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equiation, energy equation, momentum equation and moment of momentum equation.

PART A

1. A soap bubble is formed when the inside pressure is 5 N/m^2 above the atmospheric pressure. If surface tension in the soap bubble is 0.0125 N/m, find the diameter of the bubble formed. **[APRIL'10/1]**

2. The converging pipe with inlet and outlet diameters of 200 mm and 150 mm carries the oil whose specific gravity is 0.8. The velocity of oil at the entry is 2.5 m/s, find the velocity at the exit of the pipe and oil flow rate in kg/sec. **[APRIL'10/2]**

3. What is the variation of viscosity with temperature for fluids? **[NOV'09/1]**

4. Find the height of a mountain where the atmospheric pressure is 730 mm of Hg at Normal conditions. **[NOV'09/2]**

5. What is meant by vapour pressure of a fluid? **[APRIL'10 R-04/1]**

6. Distinguish between atmospheric pressure and gauge pressure. **[APRIL'10 R-04/2]**

7. What are Non-Newtonian fluids? Give examples. **[NOV'09 R-04/1]**

8. Mention the uses of a manometer. **[NOV'09 R-04/2]**

9. What do you mean by absolute pressure and gauge pressure? **[MAY'09 R-04/1]**

10. Define the term Kinematic Viscosity and give its dimension. **[MAY'09 R-04/2]**

11. What is meant by continuum? **[NOV'08 R-04/1]**

12. State Pascal's hydrostatic law. **[NOV'08 R-04/2]**

13. What is specific gravity? How is it related to density? **[APRIL'08 R-04/1]**

14. How does the dynamic viscosity of liquids and gases vary with temperature? **[APRIL'08 R-04/2]**

15. How does the dynamic viscosity of (a) liquids and (b) gases vary with temperature?

[NOV'07 R-04/1]

16. What is the difference between gauge pressure and absolute pressure? **[NOV'07 R-04/2]**

17. Differentiate between solids and liquids. **[MAY'07 R-04/1]**

18. Define the following terms : **[MAY'07 R-04/2]**
    (a)Total pressure
    (b)Centre (or) position of pressure.

19. What is meant by capillarity? **[NOV'06 R-04/1]**

20. Define buoyancy. **[NOV'09 R-04/2]**

21. What is viscosity? What is the cause of it in liquids and in gases? **[NOV'05/1]**

22. State Pascal's law. **[NOV'05/2]**

PART B

23. A drainage pipe is tapered in a section running with full of water. The pipe diameters at the inlet and exit are 1000 mm and 500 mm respectively. The water surface is 2 m above the centre of the inlet and exit is 3 m above the free surface of the water. The pressure at the exit is 250 mm of Hg vacuum. The friction loss between the inlet, and exit of the pipe is 1/10 of the velocity head at the exit. Determine the discharge through the pipe . **[APRIL'10/11(a)]**

24. A pipe of 300 mm diameter inclined at 30° to the horizontal is carrying gasoline (specific gravity = 0.82). A Venturimeter is fitted in the pipe to find out the flow rate whose throat diameter is 150 mm. The throat is 1.2 m from the entrance along its length. The pressure gauges fitted to the Venturimeter read 140 kN/m^2 and 80 kN/m^2 respectively. Find out the coefficient of discharge of Venturimeter if the flow is 0.20 m^3/s. **[APRIL'10/11(b)]**

25. Explain the properties of a hydraulic fluid. **[NOV'09/11(a)]**

26. A 0.5 m shaft rotates in a sleeve under lubrication with viscosity 5 poise at 200 rpm. Calculate the power lost for a length of 100 mm if the thickness of the oil is 1 mm. **[NOV'09/11(b)]**

27. (i) Derive Bernoulli's theorem and state its limitations. **[APRIL'10 R-04/12b(i)]**

28. (ii) A horizontal Venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If $C_d = 0.98$, determine the rate of flow. **[APRIL'10 R-04/12b(ii)]**

29. Derive continuity equation from basic principles. **[NOV'09 R-04/12a (i)]**

30. Derive Euler's equation of motion for flow along a stream line. What are the assumptions involved. **[NOV'09 R-04/12b(ii)]**

31. A horizontal pipe carrying water is gradually tapering. At one section the diameter is 150 mm and flow velocity is 1.5 m/s. If the drop in pressure is 1.104 bar at a reduced section, determine the

diameter of that section. If the drop is 5 kN/m^2, what will be the diameter — Neglect losses?
[NOV'09 R-04/12b(ii)]

32. State Bernoulli theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli equation and state the assumptions made. **[MAY'09/12b(i)]**

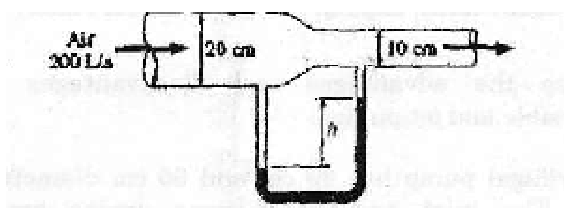
33. A 15 cm diameter vertical pipe is connected to 10 cm diameter
Vertical pipe with a reducing socket. The pipe carries a flow of 100 1/s. At point 1 in 15 cm pipe gauge pressure is 250 kPa. At point 2 in the 10 cm pipe located 1.0 m below point 1 the gauge pressure is 175 kPa.

(1) Find whether the flow is upwards / downwards.
(2) Head loss between the two points **[NOV'08 R-04/12a(i)]**

34. Differentiate Venturimeter andOrificemeter. **[NOV'08 R-04/12a(ii)]**

35. State and prove Bernoulli's Theorem **[NOV'08 R-04/12b(i)]**

36. Air flows through a pipe at a rate of 200 L/s. The pipe consists of two sections of diameters 20 cm and 10 cm with a smooth reducing section that connects them. The pressure difference between the two pipe sections is measured by a water manometer. Neglecting frictional effects, determine the differential height of water between the two pipe sections. Take the air density to be 1.20 kg/m^3.



[MAY'08 R-04/12b(i)]

37. A Pitot-static probe is used to measure the velocity of an aircraft flying at 3000 m. If the differential pressure reading is 3 kPa, determine the velocity of the aircraft. **[MAY'08 R-04/12b(ii)]**

38. Obtain an expression for continuity equation in Cartesian coordinates.
[NOV'07 R-04/12a(i)]

39. A 300 mm x 150 mm Venturimeter is provided in a vertical pipe line carrying oil of relative density 0.9, the flow being upwards. The differential U tube mercury manometer shows a gauge deflection of 250 mm, calculate the discharge of oil, if the coefficient of meter is 0.98. **[NOV'07 R-04/12b(ii)]**

40. A horizontal venture meter of specification 200 mm x 100 mm is used to measure the discharge of an oil of specific gravity 0.8. A mercury manometer is used for the purpose. If the discharge is 100 litres per second and the coefficient of discharge of meter is 0.98, find the manometer deflection.
[MAY,07 R-04/12a(ii)]

41. Derive Bernoulli's equation along with assumptions made. **[MAY'07 R-04/12b(i)]**

42. Mention any three applications of Bernoulli's theorem. **[NOV'06 R-04/12b(i)]**

43. A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The readings of the differential manometer connected to the inlet is 180 mm of mercury. If C_d= .98, determine the rate of flow. **[N0V'06 R-04/12b(ii)]**

UNIT II FLOW THROUGH CIRCULAR CONDUITS

SYLLABUS

FLOW THROUG CIRCULAR CONDUITS **12**

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. **Hydraulic and energy gradient. Darcy – Weisbach equaition. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.**

LAMINAR FLOW THOUGH CIRCULAR CONDUITS AND CIRCULAR ANNULI

PART A

1. Differentiate between laminar and turbulent flow. **[NOV/DEC '2005/5]**

2. Write down four examples of laminar flow. **[NOV/DEC '2006/5]**

3. Sketch velocity distribution curves for laminar and turbulent flows in a pipe. **[NOV/DEC '2006/6]**

4. What is the physical significance of Reynold's number? **[MAY/JUNE '2007/5]**

PART B

5. What is meant by critical Reynolds number. **(6) [NOV/DEC '2006/13a(i)]**

6. Obtain a relationship between shear stress and pressure gradient. **(10) [NOV/DEC '2006/13a(ii)]**

7. Derive an expression for the velocity distribution for viscous flow through a circular pipe. **(8) [MAY/JUNE '2007/13a(i)]**

8. Derive Hagen- poiseuille equation state the assumptions made. **(16) [NOV/DEC '2005/14a]**

BOUNDARY LAYER CONCEPTS

PART A

1. Define boundary layer and give its significance. **[APR'10/3] [DEC '09/6]**
2. Define the term Drag and Lift**[APR'09/6] [NOV '09/6] [NOV '05/6]**

PART B

3. What do you mean by displacement thickness and momentum thickness? (6) **[NOV '08/13b(ii)]**

4. The velocity distribution in the boundary layer is given by $u/U = y/\delta$, where u is the velocity at a distance y from the plate u=U at $y = \delta$, δ being boundary layer thickness. Find the displacement thickness, momentum thickness and energy thickness. (16) **[APR'10/13b]**

5. A flat plate 1.5 m x 1.5 m moves at 50 km/h in a stationary air of density 1.15 kg/m^3. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine (i) the lift force (ii) the drag force (iii) the resultant force and (iv) the power required to set the plate in motion. (16) **[NOV '09/13b]**

FLOW THROUGH PIPES

PART A

1. List any four minor losses in a pipe flow. **[MAY/JUNE '2007/6] [JUNE'10 R-4/4]**
2. What is meant by equivalent pipe? **(6) [NOV/DEC '2006/13b(i)]**
3. Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. Rate of flow of water through the pipe is 250 litres/s. **[JUNE '10/4]**
4. List the causes of minor energy losses in flow through pipes. **[DEC '09/3]**
5. What is T.E.L.? **[DEC '09/4]**
6. What is Hydraulic Gradient Line? **[JUNE '09/6]**

PART B

9. Derive an expression for head loss through pipes due to friction. (16) **[JUNE'10 R-4/13a]**

10. Explain the losses of energy in flow through pipes. (16) **[DEC '09/12a]**

11. Determine the equivalent pipe corresponding to 3 pipes in series with lengths and diameters L1,L2,L3,d1,d2,d3 respectively. (16) **[DEC '09/12b]**

12. The velocity of water in a pipe 200mm diameter is 5m/s. The length of the pipe is 50m. Find the loss of head due to friction, if f= 0.08. **(4) [NOV/DEC '2005/14b(ii)]**

13. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec.The diameter of the pipe which is 20 cm is suddenly enlarged to 40 cm. The pressure intensity in the smaller pipe is 11.772 N/cm^2.
    Determine :
    Loss of head due to sudden enlargement,
    Pressure intensity in larger pipe,
    Power loss due to enlargement. (9) **[JUNE '09/13a(i)]**

14. An oil of sp.gravity 0.7 is flowing through a pipe of diameter 30 cm at the rate of 500 litres/sec. Find the head lost due to friction and power required to maintain the flow for a length of 1000 m. Take υ= 0.29 stokes. (8) **[JUNE '09/13b(ii)]**

15. Three pipes of 400 mm, 350 mm and 300 mm diameter are connected in series between two reservoirs. With a difference in level of 12 m. Friction factor is 0.024, 0.021 and 0.019 respectively. The lengths are 200 m, 300 m and 250 m. Determine flow rate neglecting minor losses. (8) **[DEC '09 R-4/13a(ii)]**

16. A main pipe divides into two parallel pipes, which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1 m respectively, while the length and diameter of second parallel pipe are 2000 m and 0.8 m respectively. Find the rate of flow in each parallel pipe, if total flow in the main is $3 m^3/s$. The coefficient of friction for each parallel pipe is same and equal to 0.005. **(8) [MAY/JUNE '2007/13a(ii)]**

17. Two pipes of 15 cm and 30 cm diameters are laid in parallel to pass a total discharge of 100 liters per second. Each pipe is 250 m long. Determine discharge through each pipe. Now these pipes are connected in series to connect two tanks 500 m apart, to carry same total discharge. Determine water level difference between the tanks. Neglect minor losses in both cases, f = 0.02 both pipes. **(8) [MAY/JUNE '2007/13b(i)]**

18. Two pipes of identical length and material are connected in parallel. The diameter of pipe A is twice the diameter of pipe B. Assuming the friction factor to be the same in both cases and disregarding minor losses, determine the ratio of the flow rates in the two pipes.(8) **[JUNE '08/13a(ii)]**

19. For a town water supply, a main pipe line of diameter 0.4 m is required. As pipes more than 0.35m diameter are not readily available, two parallel pipes of same diameter are used for water supply. If the total discharge in the parallel pipe is same as in the single main pipe, find the diameter of parallel pipe. Coefficient of discharge to be the same for all the pipes. **[JUNE '10/13a]**

20. A pipe line 10km, long delivers a power of 50 kW at its outlet ends. The pressure at inlet is 500 kN/m^2 and pressure drop per km of pipeline is 50 kN/m. Find the size of the pipe and efficiency of transmission. Take 4f= 0.02.**(12) [NOV/DEC '2005/14b(i)]**

21. A 2500 m long pipeline is used for transmission of power. 120 kW power is to be transmitted through the pipe in which water having a pressure of 4000 kN/m^2 at inlet is flowing. If the pressure drop over the length of pipe is 800 kN/m^2 and f = .006. find
    (1) Diameter of pipe and
    (2) Efficiency of transmission. **(10) [NOV/DEC '2006/13b(ii)]**

22. A power transmission pipe 10 cm diameter and 500 m long is fitted with a nozzle at the exit, the inlet is from a river with water level 60 m above the discharge nozzle. Assume f = 0.02, calculate the maximum power which can be transmitted and the diameter of nozzle required. (10) **[DEC '08/13b(i)]**

UNIT III DIMENSIONAL ANALYSIS

SYLLABUS

DIMENSIONAL ANALYSIS	**9**
Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters.	

Dimensional Analysis

PART A

1. What do you understand by fundamental units and derived units? **[JUNE '10/6]**
2. What is Dimensionally Homogeneous equation and give an example? **[JUNE '09-R04/3]**
3. State the advantages of Dimensional and model analysis. **[JUNE'09R-04/4]**
4. State Buckingham's π theorem. **[DEC '06/7]**

PART B

1. What are the criteria for selecting repeating variable in this dimensional analysis? (6) **[JUNE'09R-04/12b(ii)]**

2. The resisting force(R) of a supersonic flight can be considered as dependent upon the length of the air craft 'l', velocity 'v' , air viscosity 'μ', air density 'ρ' and bulk modulus of air is'k'. Express the functional relationship between these variables and the resisting force. **[DEC '05/13b(i)]**

3. Using Buckingham's π theorem, show that velocity, through a circular pipe orifice is given by *H-head* causing flow; *D-dia* of orifice μ = Coefficient of viscosity ρ = mass density; g = acceleration due to gravity. **[DEC '06/14a(ii)]**

4. The efficiency (η of a fan depends on ρ (density), μ (viscosity) of the fluid, □ (angular velocity), d (diameter of rotor) and Q (discharge). .Express η in terms of non-dimensional parameters. Use Buckingham's π theorem. **[JUNE '10/13b] [DEC '09/13(a)]**

5. Using Buckingham's π- theorem, show that the velocity through a circular orifice in a pipe is given by $\mathbf{v = \sqrt{(2gH)}\, f \{d/H , \mu/\rho v H\}}$ where v is the velocity through orifice of diameter d and H is the head causing the flow and ρ and μ are the density and dynamic viscosity of the fluid passing through the orifice and g is acceleration due to gravity. **[JUNE '10/13a]**

Models & Similitude

PART A

1. What is meant by dynamic similarity? **[DEC '08/4]**
2. What is dynamic similarity? **[DEC '09/5]**

3. Define Froude's number. **[DEC '09/6]**

PART B

4. Classify Models with scale ratios. **[DEC '09/13b]**

QUESTIONS FROM CIVIL ENGINEERING

Similitude and models

PART A

1. Define Reynolds number and Mach number. **[APR'07/9]**
2. What are the applications of model testing? **[APR'10/9]**
3. Give two examples of a fluid flow situation where Froude model law in applied. **[NOV'09 /10]**
4. What is a distorted model? What are its advantages?**[APR'10R-04/10][APR'08/10][NOV'06 /10] [NOV'05 /10]**
5. What are the types of similarities? **[APR'07/10]**
6. What is kinematic similarity? **[NOV'06 /9]**
7. What is meant by similitude? **[NOV'08 /10]**

PART B

8. Write short notes on the following:
(i) Dimensionless Homogenity with example. (4)
(ii) Euler Model Law. (4)
(iii) Similitude. (4)
(iv) Undistorted and Distorted Models. (4) **[NOV'09 /15b]**

9. Explain Reynold's law of similitude and Froude's law of similitude. **[NOV'08 /15b(i)]**

10. Explain Reynold's law of similitude and Froude's law of similitude. (8) **[APR'10R-04/15b(i)]**

11. Explain different types of similarities. (8) **[APR'08/15a(ii)]**

12. What is meant by scale effect? (4) **[APR'08/15a(iii)]**

13. Define dynamic similarity with suitable example. (4) **[NOV'05 /15a(i)]**

14. In an aeroplane model of size (1/10) of its prototype, the pressure drop is 7.5 kN/m^2.The model is tested in water. Find the corresponding pressure drop in the prototype. Assume density of air = 1.24 kg/m^3 , density of water = 1000 kg/ m^3 : viscosity of air = 0.00018 Poise; viscosity of water = 0.01 Poise. (8) **[APR'10R-04/15b(ii)]**

15. In 1:30 model of a spillway, the velocity and discharge are 1.5 m/s and 2.0 m^3/s. Find the corresponding velocity and discharge in the prototype**. [NOV'08 /15b(ii)]**

16. A spillway model is built to a scale ratio of 1:50. The prototype is 15 m high and the maximum head expected is 2 m. Find

(i) height of the model and head on the model

(ii) the flow over the prototype when the flow over the model is 10 lps.(16) **[APR’08/15b]**

17. Model of an air duct operating with water produces a pressure drop of 10 kN/m^2 over 10 m length. If the scale ratio is 1/50. Density of water is 1000 kg/m^3 and density of air is 1.2 kg/m^3. Viscosity of water is 0.001 Ns/m^2 and viscosity of air is 0.00002 Ns/m^2. Estimate corresponding drop in a 20 m long air duct. (13) **[APR’07/15a(ii)]**

18. It is desired to obtain dynamic similarity between a 30 cm diameter pipe carrying linseed oil at 0.5 m^3/sec and a 5 m diameter pipe carrying water. What should be the rate of flow of water in lps. If the pressure loss in the model is 196 N/m^2, what is the pressure loss in the prototype pipe. Take kinematic viscosities of linseed oil and water as 0.457 and 0.0113 stokes respectively. Take specific gravity of linseed oil as 0.82. (16) **[NOV’06 /15b]**

19. The pressure drop in an aero-plane model of size 1/10 of its proto type is 80 N/cm^2. The model is tested in water. Find the corresponding pressure drop in the proto type. Take density of air and water are 1.24 kg/m^3 and 1000 kg/m3. The viscosity of air and water are 0.000018 Ns/m^2 and 0.001 Ns/m^2 respectively. (12) **[NOV’05 /15a(ii)]**

UNIT IV PUMPS

Centrifugal Pumps

PART A

1. The following data refer to a centrifugal pump which is designed to run at 1500 rpm. D_1 - 100 mm, D_2 = 300 mm, B_1 = 50 mm, B_2 = 20 mm, V_{f1} = 3 m/s, β = 60°. Find the velocity of flow at outlet. **[APRIL 2010/7]**

2. What is meant by priming of pumps? Why is priming necessary in centrifugal pumps? **[APRIL 2010 R-04/9] [MAY 2007 /8] [APRIL 2008/9]**

3. Define cavitation in a pump. **[MAY/JUNE '2007/7]**

4. What is the maximum theoretical suction head possible for a centrifugal pump? **[APRIL 2008/10]**

5. What is the role of volute chamber of a centrifugal pump? **[NOV/DEC '2005/10]**

PART B

6. Determine the minimum speed for starting a centrifugal pump. **[NOV/DEC '2009/15a]**

7. Explain the characteristic curves of a centrifugal pump. **[NOV/DEC '2009/15b]**

8. Describe with a sketch the installation and operation of centrifugal pump **[NOV 2009 R-04/14a(i)]**

9. (b) A centrifugal pump running at 800 rpm is working against a total head of 20.2 m. The external diameter of the impeller is 480 mm and the outlet width is 60 mm. If the vane angle at outlet is 40° and manometric efficiency is 70%,

Determine:

(i) Flow velocity at outlet,
(ii) Absolute velocity of water leaving the vane.
(iii) Angle made by the absolute velocity at outlet with the direction of motion,
(iv) Rate of flow through the pump. **[APRIL 2010 R-04/15b]**

10. Compute the overall efficiency of a centrifugal pump from the following test data. Suction gauge reading = 27.5 KPa (vac) and delivery gauge reading =152 (gauge) height of delivery gauge over suction gauge is 0.4 m, discharge is 2100 mm. Diameter of suction pipe is 15 cm and diameter of delivery pipe is 10 cm. The motor power = 12 MHP and fluid is water. **[NOV 2009 R-04/14a(ii)]**

11. (ii) A Centrifugal pump is provided at a height of 5 m above the sump water level and the outlet of the delivery pipe is 10 m above the sump. The vane angle at outlet is 50°. The velocity of flow through the impeller is constant at 1.6 m/s. Find :

(1) The pressure head at inlet to the wheel (10)
(2) The pressure head at outlet of the wheel. Assume that the velocity of water in the pipes is equal to the velocity of flow through the impeller. Ignore losses. **[NOV/DEC '2008/15a(ii)]**

12. A centrifugal pump has 30 cm and 60 cm diameters at inlet and outlet. The inlet and outlet vane angles are 30° and 45° respectively. Water enters at a velocity of 2.5 m/s radially. Find the speed of impeller in rpm and power of the pump if the flow is $0.2 m^3/s$. **[APRIL '2008/15a(ii)]**

13. A centrifugal pump delivers water against a net head of 14.5 metres and a design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump if manometric efficiency is 95%.

[NOV/DEC '2007/15a(i)]

Reciprocating pump

PART A

40. Define slip of reciprocating pump. **[APRIL 2010/7]**

41. Mention the working principle of an Air-vessel. **[APRIL 2010/10]**

42. Can actual discharge be greater than theoretical discharge in a reciprocating pump? **[NOV/DEC '2009/9]**

43. Which factor determines the maximum speed of a reciprocation pump? **[NOV/DEC '2009/10]**

44. What are the functions of an air vessel? **[APRIL 2010 R-04/10] [MAY 2009/9]**

45. What is specific speed of a pump? How are pumps classified based on this number? **[MAY/JUNE '2009/9]**

46. When do negative slip occur? **[NOV 2008/10]**

47. Define slip of a reciprocating pump. **[NOV 2007/10]**

48. When will you select a reciprocating pump? **[NOV 2005/9]**

PART B

49. Show that the work done by a reciprocating pump is equal to the area of the indicator diagram. **[APRIL 2010 R-04/15a(i)]**

50. Classify pumps. Explain the working of a double acting reciprocating pump with a neat diagram. **[APRIL 2010 R-04/15a(ii)]**

51. Explain the working principle of reciprocating pump with neat sketch

[NOV 2008/15a(i)] [NOV 2005/11(a)]

52. Define cavitation and discuss its causes, effects and prevention

[APRIL 2008/15b(i)]

53. Calculate the work saved by fitting an air vessel for a double acting single cylinder reciprocation pump. **[APRIL 2008/15b(ii)]**

54. The diameter and stroke of a single acting reciprocating pump are 120 mm and 300 mm respectively. The water is lifted by a pump through a total head of 25 m. The diameter and length of delivery pipe are 100 mm and 20 rn respectively. Find out:

(i) Theoretical discharge and theoretical; power required to run the pump if its speed is 60rpm

(ii) Percentage slip, if the actual discharge is 2.35 1/s and

(iii) The acceleration head at the beginning and middle of the delivery stroke.

[APRIL 2010/15a]

55. Determine the maximum operating speed in rpm and the maximum capacity in lps of a single-acting reciprocating pump with the following details. Plunger diameter = 25 cm, stroke = 50 cm, suction pipe diameter = 15 cm, length = 9 cm, delivery pipe diameter = 10 cm, length = 36 cm, static suction head = 3 m, static delivery head = 20 m, atmospheric pressure - 76 cm of mercury, vapour pressure of water = 25 KPa (abs). **[Nov 2009 R-04/14b(iii)]**

56. A double acting pump with 35cm bore and 40cm stroke runs at 60 strokes per minute. The suction pipe is 10 m long and delivery pipe is 200m long. The diameter of the delivery pipe is 15cm.The pump is situated at a height of 2.5 m above the sump, the outlet of the delivery pipe is 70 m above the pump. Calculate the diameter of the suction pipe for the condition that separation is avoided. Assume separation to occur at an absolute pressure head is 2.5m of water. Find the Horsepower required to drive the pump neglecting all losses other than friction in the pipes assuming friction factor as 0.02. **[NOV 2008/15b(ii)]**

57. A single acting reciprocating pump running at 50 rpm, delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine the theoretical discharge of the pump, coefficient of discharge and slip and the percentage slip of the pump. **[NOV 2007/15a(ii)]**

ROTARY PUMPS

PART A

1. What are Roto dynamic pumps? Give examples. **[Nov 2009 R-04/7]**

PART B

2. Explain the working of the working of following pumps with the help of neat sketches and mention two, applications of each.
   (i) External gear pump (ii) Lobe pump
   (iii) Vane pump (iv) Screw pump. **[APRIL 2010/15(b)]**

3. Explain the working principle of Gear pump with neat sketch **[NOV 2008/15b(i)]**

4. Explain the working principles of vane pump and gear pump with neat sketches. **[NOV 2007/15b(i)]**

UNIT V TURBINE

PART A

1. Differentiate between the turbines and pumps. **[NOV/DEC '2007/7]**
2. How are Hydraulic turbines classified? **[MAY/JUNE '2009/8]**
3. Classify turbines according to flow. **[NOV/DEC '2005/8]**
4. What are high head turbines? Give examples. **[NOV 2009 R-04/9]**
5. Define hydraulic efficiency of a turbine. **[NOV/DEC '2006/9]**

6. The mean velocity of the buckets of the Pelton wheel is 10 m/s. The jet supplies water at 0.7 m^3/s at a head of 30 m. The jet is deflected through an angle of 160° by the bucket. Find the hydraulic efficiency. Take C_v = 0.98. **[APRIL 2010/7]**

7. Define specific speed. **[NOV/DEC '2009/7] [NOV/DEC '2005/7] [MAY/JUNE '2007/10] [NOV/DEC '2007/8]**

8. What are the different types of draft tubes? **[APRIL 2010 R-04/8] [NOV 2009/8]**

9. What are the functions of a draft tube? **[NOV 2009 R-04/10] [MAY/JUNE '2007/9]**

10. What is a draft tube for Kaplan turbine? **[NOV/DEC '2006/10]**

PART B

11. Give the comparison between impulse and reaction turbine. **(8) [NOV/DEC '2005/15a(i)]**

12. Write a note on performance curves of turbine. **[APRIL 2010 R-04/14a(i)]**

13. Write a short note on Governing of Turbines. . **[NOV 2008 14a(i)]**

14. Derive an expression for the efficiency of a draft tube. **(6) [NOV/DEC '2006/15b(i)]**

PELTON WHEEL

15. With the help of neat diagram explain the construction and working of a pelton wheel turbine. **(8) [NOV/DEC '2005/15b(i)] [APRIL 2010 R-04/14a(ii)]**

16. What is the condition for hydraulic efficiency of a pelton wheel to be maximum ? **(8) [NOV/DEC '2005/15b(ii)]**

17. Sketch velocity triangles at inlet and outlet of a pelton wheel. **(6) [NOV/DEC '2006/15a(i)]**

18. Show that the overall efficiency of a hydraulic turbine is the product of volumetric, hydraulic and mechanical efficiencies. **(8) [MAY/JUNE '2007/15b(ii)]**

19. Obtain an expression for the workdone per second by water on the runner of a Pelton wheel. Hence derive an expression for maximum efficiency of the Pelton wheel giving the relationship between the jet speed and bucket speed. **[NOV/DEC '2007/14a]**

20. A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm. The net head on the Pelton wheel is 700 m. If the side clearance angle is 15° and discharge through nozzle is 0.1 m^3/s, find
    (1) power available at the nozzle and
    (2) hydraulic efficiency of the turbine. Take $C_v = 1$. **[NOV/DEC '2007/14b(i)]**

21. A Pelton wheel has a mean bucket speed of 12 m/s and supplied with water at the rate of 0.7 m^3/s under a head of 300 m. If the buckets deflect the jet through an angle of 160° find the power developed and hydraulic efficiency of the turbine. (10) **[APRIL '2008/14a(i)]**

22. The nozzle of a Pelton wheel gives a jet 9 cm diameter and velocity 75 m/s. C_v of nozzle = 0.978. The pitch circle diameter is 1.5 m and the deflection angle of the buckets is 170°. The wheel velocity is 0.46 times the jet velocity. Estimate the speed in rpm, theoretical power developed and the efficiency of the machine. . **[NOV 2009 R-04/15a(ii)]**

23. A Pelton wheel has a mean bucket speed of 10 meters per second with a jet of water

flowing at the rate of 700 litres/sec under a head of 30 meters. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity 0.98. **[MAY/JUNE '2009/14a(i)]**

24. Determine the hp of the pelton wheel with tangential velocity 20 m/s, Head 50 m, discharge Q = 0.03 m^3/s , side clearance angle 15°. take C_v as 0.975. **[NOV/DEC '2009/14a]**

25. A Pelton turbine having 1.6 m bucket diameter develops a power of 3600 KW at 400 rpm, under a net head of 275 m. If the overall efficiency is 88%, and the coefficient of velocity is 0.97, find: speed ratio, discharge, diameter of the nozzle and specific speed. **(8) [MAY/JUNE '2007/15a(ii)]**

26. A Pelton wheel supplied water from reservoir under a gross head of 112 m and the friction losses in the pen stock amounts to 20 m of head. The water from pen stock is discharged through a single nozzle of diameter of 100 mm at the rate of 0.30 m^3/s. Mechanical losses due to friction amounts to 4.3 KW of power and shaft power available is 208 KW. Determine: velocity of jet; water power at inlet to runner; power loss in nozzles; power lost in runner due to hydraulic resistance. **(8) [MAY/JUNE '2007/15b(i)]**

27. A Pelton wheel has to be designed for the following data. Power to be developed = 6000 kW; Net head available = 300 m; Speed = 550 rpm; Ratio of jet diameter to wheel diameter = and overall efficiency = 85%. Find the no. of jets, diameter of the- jet, diameter of the wheel and the quantity of water required. **(10) [NOV/DEC '2006/15a(ii)]**

KAPLAN TURBINE

28. Draw a neat sketch of Kaplan turbine, name the parts and briefly explain the working.**(8) [MAY/JUNE '2007/15a(i)]**

29. Explain with the help of a diagram, the essential features of a KaplanTurbine. . **[NOV 2009 R-04/15a(i)]**

30. A Kaplan turbine working under a head of 20 m develops 15 MW brake power. The hub diameter and runner diameter of the turbine are 1.5 m and 4 m respectively. The guide blade angle at the inlet is 30°. η_n =0.9 and η_o= 0.8. The discharge is radial. Find the runner vane angles and turbine speed. **[APRIL 2010/14b]**

31. A Kaplan turbine runner is to be designed to develop 7357.5 kW shaft power. The net available head is 5.50 m. Assume that the speed ratio is 2.09 and flow ratio is 0.68, and the overall efficiency is 60%. The diameter of the boss is l/3rd of the diameter of the runner. Determine the diameter of the runner, its speed and its specific speed. **[MAY/JUNE '2009/14b(i)]**

32. Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 kW under an effective head of 5 m. Overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 2.0 and flow ratio 0.6. **(10) [NOV/DEC '2006/15b(ii)]**

FRANCIS TURBINE

33. A Francis turbine with an overall efficiency of 76% and hydraulic efficiency of 80% is required to produce 150 kW. It is working under a head of 8 m. The peripheral velocity is **$0.25\sqrt{2gH}$** and radial'velocity of flow at inlet is **$0.95\sqrt{2gH}$**. The wheel runs at 150 rpm. Assuming radial discharge, determine
(i) Flow velocity at outlet
(ii) The wheel angle at inlet
(iii) Diameter and width of the wheel at inlet **[APRIL 2010 R-04/14b]**

34. Design a Francis Turbine runner with the following data: Net head = 70 m Speed N f-800 rpm. Output power 400 Kw Hydraulic efficiency = 95% Overall efficiency = 85% Flow ratio = 0.[illegible] Breadth ratio = 0.1 Inner diameter is 1/3 outer diameter. Assume 6% circumferential area of the runner to be occupied by the thickness of the vanes. The flow is radial at exit and remains constant throughout. **[NOV 2008 14a(ii)]**

INWARD RADIAL FLOW TURBINE

35. In an inward radial flow turbine, water enters at an angle of 22° to the wheel tangent to the outer rim and leaves at 3 m/s. The flow velocity is constant through the runner. The inner and outer diameters are 300 mm and 600 mm respectively. The speed of the runner is 300 mm. The discharge through the runner is radial. Find the
(i) Inlet and outlet blade angles
(ii) Taking inlet width as 150 mm and neglecting the thickness of the blades, find the power developed by the turbine **[APRIL 2010/14a]**

36. The inner and outer diameters of an inward flow reaction turbine are 50 cm and 100 cm respectively. The vanes are radial at inlet and discharge is also radial. The inlet guide vanes angle is 10°. Assuming the velocity of flow as constant and equal to 3m/s find the speed of the runner and the vane angle at the outlet. **[APRIL '2008/14b(i)]**

37. A reaction turbine at 450 rpm, head 120 m, diameter at inlet 120 cm, flow area 0.4 m^2 has angles made by absolute and relative velocities at inlet 20° and 60° respectively. Find olvume flow rate, H.P. and Efficie ncy **[NOV/DEC '2009/14b]**

38. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90% determine, specific speed of the machine, power generated and type of turbine. **[NOV/DEC '2007/14b(ii)]**

39. In a hydroelectric station. Water is available at the rate of 175 m^3/s under head of 18m. The turbine run at a speed of 150 rpm, with overall efficiency of 82% find the number of turbines required, if they have the maximum specific speed of 460. **(8) [NOV/DEC '2005/15a(ii)]**