**DEPARTMENT OF HARBOUR AND OCEAN ENGINEERING**

**QUESTION BANK**

**COURSE: FLUID MECHANICS (HE304) YEAR/SEM: 2ND /III**

**UNIT-I-FLUID PROPERTIES**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define Viscosity.
2. List out different types of fluids?
3. Define specific weight of a liquid and gases.
4. Define fluid mechanics.
5. What is Cavitations?
6. What is adhesion and cohesion of liquids.
7. Falling drops of rain acquire spherical shape on account of --------------------.
8. The viscosity of an oil is 20 Poise, convert it into stokes.
9. Write the dimensions for specific weight ----------------------------------------.
10. Write the dimensions for the kinematic viscosity--------------------.

**PART-A**

**EACH QUESTION CARRIES 4 MARKS**

1. Discuss about surface tension and Capillary rise.
2. Discuss about the thermodynamic properties of a fluids.
3. Find the kinematic viscosity of an oil having density 981 kg/m3. The shear stress at a point in oil is 0.2452 N/m2 and velocity gradient at that point is 0.2 per second.
4. Define the term continuum with a neat sketch.
5. Calculate the density, specific weight and weight of one litre of petrol of specific gravity =0.7
6. Discuss about the control volume of a fluid.
7. State Pascal’s law.
8. What is mean by absolute and gauge pressure and vacuum pressure?
9. Define Manometer and list out it’s types.
10. Write short notes on ‘Differential Manometers’.
11. Define centre of pressure and total pressure.
12. Define buoyancy and centre of buoyancy.
13. Define Meta centre.
14. Define Hydro static Pressure.
15. A differential manometer is connected at the two points A and B. At B pressure is 9.81N/cm2 (abs). Find the absolute pressure at A.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Discuss about the properties of fluids.
2. Derive an expression for surface tension on a liquid droplet.
3. The space between tow square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine:
4. The dynamic viscosity of the oil in poise and
5. The Kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95
6. Derive the expression for the following
7. Bulk modulus
8. Compressibility
9. Determine the Bulk modulus elasticity of a liquid, if the pressure of the liquid is increased from 70 N/Cm2, to 130 N/cm2. The volume of liquid decreased by 0.15%.
10. A plate of 0.025 mm distant from a fixed plate, moves at 60cm/s and requires a force 2N/m2 to maintain the speed. Determine the fluid viscosity, density and specific weight of fluid between the plates.
11. A plate of 0.5 mm distant from a fixed plate, moves at 60cm/s and requires a force 10N/m2 to maintain the speed. Determine the fluid viscosity, density and specific weight of fluid between the plates.
12. Calculate the capillary effect in millimeters a glass tube of 4mm diameter, when immersed in (a) water (b) mercury. The temperature of the liquid is 20o C and the values of the surface tension of water and mercury at 20o C in contact with air are 0.073575 and 0.51 N/m respectively. The angle of contact for water is zero that for mercury 130o . Take specific weight of water as 9790 N/m3 .
13. If the velocity profile of a liquid over a plate is a parabolic with the vertex 202 cm from the plate, where the velocity is 120 cm/sec. calculate the velocity gradients and shear stress at a distance of 0, 10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise.
14. A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 rpm determine the viscosity of the fluid.
15. The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. the thickness of the oil film is 1.5 mm. 5. If the velocity distribution over a plate is given by u=2/3 y – y2 in which U is the velocity in m/s at a distance y meter above the plate, determine the shear stress at y = 0 and y = 0.15 m.
16. Derive expression for capillary rise and fall.
17. Two large plane surfaces are 2.4 cm apart. The space between the gap is filled with glycerin. What force is required to drag a thin plate of size 0.5 m between two large plane surfaces at a speed of 0.6 m/sec. if the thin plate is (i) in the middle gap (ii) thin plate is 0.8 cm from one of the plane surfaces? Take dynamic viscosity of fluid is 8.1 poise.
18. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (a) water (b) mercury. Take surface tension = 0.0725 N/m for water and = 0.52 N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact of mercury with glass = 130o .
19. The diameters of a small piston and a large piston of a large piston of a hydraulic jack at 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when: a. The pistons are at the same level b. Small piston in 40 cm above the large piston. The density of the liquid in the jack is given as 1000 kg/m3 .
20. A U - Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs. U tube is 10 cm and the free surface of mercury is in level with over the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2 , Calculate the new difference in the level of mercury. Sketch the arrangement in both cases.
21. A vertical sluice gate is used to cover an opening in a dam. The opening is 2 m wide and 1.2 m high. On the upstream of the gate, the liquid of sp. Gr 1.45, lies up to a height of 1.5 m above the top of the gate, whereas on the downstream side the water is available up to a height touching the top of the gate. Find the resultant force acting on the gate and position of centre of pressure. Find also the force acting horizontally at the top of the gate which is capable of opening it. Assume the gate is hinged at the bottom.

**UNIT-II-FLUID STATICS AND FLUID KINEMATICS**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. What is an intensity of Pressure ?and write the unit of pressure.
2. Define Pascal’s Law.
3. How do you calculate the discharge of the liquid using flow velocity of liquid?
4. Define the Hydrostatic Law.
5. What is vacuum pressure?
6. What is the one atmospheric pressure in height of water?
7. What is Centre of Buoyancy?
8. What is Meta-centric height?
9. Write the equation for the total energy for the flowing fluids.
10. Why mercury is used in barometers?
11. What is streamline?
12. What is the condition for Laminar flow?
13. If a floating body displaces a volume of water is 3 m3 , what is the weight of the floating body?
14. If the discharge velocity of water in a pipe flow is 0.8 m/s and diameter of the pipe is 5 cm, then find out howmuch time required to fill 50 litre tank.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Derive the expression for Pascal Law?
2. Find the volume of water displaced and position of centre of buoyancy for a wooden block of width 2.5 m and of depth of 1.5 m when it floats horizontally in water. The density of wooden block is 650 kg/m3 and its length 6.0 m.
3. List out the different types of pressure measurement device.
4. A pipe contains an oil of specific gravity 0.9. A differential manometer connected at the two points A and B shows a difference in mercury level as 15 cm. Find the difference of pressure between two points.
5. Explain in detail about the different types of fluid flow.
6. The diameters of the pipe at section 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Determine the velocity at section 2. Find also the discharge Q.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive the expression for the Hydrostatic Law.
2. Explain in detail about the conditions of equilibrium of floating bodies and submerged bodies with neat sketch.
3. Water flow through a pipe AB 1.2 m diameter at 3 m/s and the passes through a pipe BC 1.5 cm diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one third of flow in AB. The velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.
4. A rectangle pontoon is 5 m long 3 m wide and 1.20 m high. The depth of immersion of Ponton is 0.8 m in seawater if the Pontoon centre of gravity is 0.6 m above the bottom of the Ponton. Determine the Meta centric height. The density of seawater 1025 kg/m3.
5. Define the equation of continuity. Obtain an expression for continuity equation for three dimensional flow.
6. Explain in detail with neat sketch, the different types of pressure measuring devices.
7. Derive the continuity equation for a three dimensional incompressible flow.
8. Derive the Euler’s equation of motion and deduce that to Bernouillie’s equation.
9. The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper and 300 mm at the lower end, at the rate of 50 litres /s. the pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm2 .
10. An oil of sp .Gr. 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. the oil mercury differenyial manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter, Take CD = 0.98.
11. 250 litres/s of water is flowing in a pipe having a diameter of 300 mm. of the pipe is bent by 135o , find the magnitude and direction of the resultant force on the bend. The pressure of water flowing is 39.24 N/cm2 .
12. A vertical wall is of 8 m height. A jet of water is coming out from a nozzle with a velocity of 20 m/s. The nozzle is situated at a distance of 20 m from the vertical wall. Find the angle of projection of the nozzle to the horizontal so that the jet of water just clears the top of the wall.

**UNIT – III-FLUID DYNAMICS**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. What is Fluid dynamics?
2. What are all the forces present in the fluid flow?
3. What is the equations of motion in the fluid flow?
4. What is Reynold’s equation of motion in the fluid flow?
5. What is Navier-Stokes Equation in the fluid flow?
6. What is Euler’s equation of motion?
7. Write the Bernoulli’s equation for real fluid.
8. What are the assumptions made in the derivation of Bernoulli’s equation.
9. How the value of h is measured in venturimeter?
10. Write Hagen Poiseulli’s equation.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Explain the detail about Pitot-tube.
2. A Pitot-static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6 m and static pressure head is 5 m. Calculate the velocity of flow assuming the co-efficient of tube equal to 0.98.
3. What is momentum principle in the fluid flow?
4. What is orifice and what are their classification?
5. Derive the expression for the rate of flow through orifice meter.
6. Draw the neat sketch for the shear stress and velocity distribution across a section of a circular pipe.
7. Explain about the orifice meter with neat sketch?
8. Derive the expression for velocity of flow through a pipe with Pitot-tube.
9. Find the velocity of the flow of an oil through a pipe, when the difference of mercury level in a differential U-tube manometer connected to the two tapings of the pitot-tube is 100 mm. Take the co-efficient of Pitot-tube 0.98 and sp.gr.of oil = 0.8.
10. The head of water over an orifice of diameter 40 mm is 10 m. find the actual discharge and actual velocity of the jet at vena-contracta. Take Cd = 0.6 and Cv= 0.98.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive an expression for Euler’s equation of motion in the fluid flow
2. Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm2(gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at cross-section, which is 5 m above the datum line.
3. Derive the expression for rate of flow through venturimeter with neat sketch.
4. An oil of specific gravity of 0.8 is flowing through the venture meter having inlet diameter 20 cm and throat diameter 10 cm. The oil mercury differential manometer shows a reading of 25 cm. Calculate the discharge of the oil through horizontal venture meter. Take Cd = 0.0.98.
5. A pipe, through which water is flowing, is having diameters, 20 cm and 10 cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0 m/s. Find the velocity head at sections 1 and 2 and also rate of discharge.
6. The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm2, find the intensity of pressure at section 2.
7. A pipe of dimeter 400 mm carries water at a velocity of 25 m/s. The pressures at the points A and B are given as 29.43 N/cm2 and 22.563 N/cm2 respectively while the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B.
8. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm2 respectively. Co-efficient of discharge for the orifice meter is given as 0.6. Find the discharge of water through pipe.
9. Derive the expression for the Hagen Poiseulle equation.
10. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10 m. calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds.

**UNIT – IV-DEFINITION OF BOUNDARY LAYER AND FLOW THROUGH PIPES**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define Boundary layer.
2. Define Laminar sub-layer.
3. Define displacement thickness.
4. Write the Darcy-weisbach formula.
5. What is Chezy’s formula.
6. What is Hydrualic Gradient Line?
7. What is Total Energy Line?
8. What is an Equivalent Pipe?
9. What is Pipe Network?
10. What is Hardy-Cross method? Where it is used?
11. What do you mean by viscous flow?
12. What is Hagen Poisuille’s formula? 3. Define Kinetic energy correction factor?
13. Define momentum correction factor?
14. Define hydraulic gradient line. 6. Define the major energy loss and minor energy loss.
15. Define water hammer in pipes.
16. Define incompressible flow.
17. Write down the examples of laminar flow/viscous flow.
18. What are the characteristics of laminar flow?
19. Write down chezy’s formula.
20. Write down the formula for finding the head loss due to entrance of pipe hi?
21. Write down the formula for efficiency of power transmission through pipes?
22. Give an expression for loss of head due to sudden enlargement of the pipes.
23. Give an expression for momentum integral equation of the boundary layer?
24. Differentiate between steady flow and uniform flow.
26. Give an expression for co efficient of friction in terms of shear stress.
27. Give an expression for loss of head due to sudden contraction.
28. Give an expression for loss of head at the entrance of the pipes.
29. Derive an expression for drop of pressure for a given length of a pipe.
30. Define Darcy formula.
31. What are the factors influencing the frictional loss in pipe flow.

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Define laminar boundary layer and turbulent boundary layer
2. Derive the expression for the flow through in series pipes.
3. Derive the expression for the flow through in parallel pipes.
4. Discuss about major and minor loss in the pipes.
5. Find the head lost due to friction in a ipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Daricy-Weisbach formula and (ii) Chezy’s Formula. Take kinematic viscosity of water = 0.01 stokes.
6. An oil of sp.gr. 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/s. Find the head lost due to friction for a 500 m length of pipe. And find the power required to maintain this flow.
7. What do you mean by Laminar Sub – layer?
8. State Boundary layer theory.
9. A crude of oil of kinematic viscosity of 0.4 stoke is flowing through a pipe of diameter 300mm at the rate of 300 liters/sec. Find the head lost due to friction for a length of 50m of the pipe.
10. Find the type of flow of an oil of relative density 0.9 and dynamic viscosity 20 poise, flowing through a pipe of diameter 20 cm and giving a discharge of 10lps.
11. Write down the values of boundary layer thickness and drag co – efficient for Blasius’s solution.
12. Write down the values of boundary layer thickness and drag co – efficient for velocity profile u/U = 2 (y/ δ) – (y/ δ) 2 19. Write down the values of boundary layer thickness and drag co – efficient for velocity profile u/U = 2 (y/ δ) – 2(y/ δ) 3 +(y/ δ) 4
13. Write down the values of boundary layer thickness and drag co – efficient for velocity profile u/U = sin (π y/2 δ).
14. Write down the values of boundary layer thickness and drag co – efficient for velocity profile u/U =3/2 (y/ δ) – 1/2(y/ δ) 3.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. Derive the expression for the loss of head due to:
2. Sudden enlargement
3. Sudden contraction of a pipe.
4. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when the one end of the pipe is connected to a tank and other end of the pipe is open end of the pipe is open to the atmosphere. The pipe in horizontal and the height of water in tank is 4m above the centre of the pipe . Consider all minor losses and take f=0.009 in the Darcy-Weisbach formula.
5. Three pipes of lengths 800m, 500m and 400m and diameter 500 mm, 400mm and 300 mm respectively are connected in series. Three pipes are replaced by single pipe of length 1700. Find the diameter of the pipe.
6. A main pipes divides into two parallel pipes which gain forms one pipe which gain. The length and diameter for the first parallel pipe are 2000 m and 1.0 respectively. While the length and diameter of the second parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe, if the total flow in the main is 3.0 m3/s. The coefficient of friction for each parallel pipe is same and equal to 0.005.
7. What is Pipe Network ?and How the distribution of flow is determined in the pipe network system?
8. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula, (ii) Chezy’s formula for which C = 60.
9. An oil of sp.Gr 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/sec./ find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow.
10. The rate of flow of water through a horizontal pipe is 0.25 m3 /s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller is 11.772 N/cm2 . Determine: (i) loss of head due to sudden enlargement, (ii) pressure intensity in the large pipe, (iii) power lost due to enlargement.
11. A horizontal pipe line 40 m long is connected to a water tank at one end 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 the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of the pipe.
12. A pipe line, 300 mm in diameter and 3200 m long is used to pump up 50 kg per second of oil whose density is 950 kg/m3 and whose kinematic viscosity is 2.1 stokes. The centre of the pipe line at the upper end is 40 m above than that at the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient and the total energy line.
13. A siphon of diameter 200 mm connects two reservoirs having a difference in elevation of 15 m. The total length of the siphon is 600 mm and the summit is 4 m above the water level in the upper reservoir. If the separation takes place at 2.8 m of water absolute, find the maximum length of siphon from upper reservoir to the summit. Take f = 0.004 and atmospheric pressure = 10.3 m of water.
14. The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12m. Determine the rate of flow of water if co – efficient of friction are 0.005, 0.0052 and 0.0048 respectively, considering: (i) minor losses also (ii) neglecting minor losses.
15. A main pipe is divided into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 3 m3 /s. The co efficient of friction for each parallel pipe is same and equal to 0.005.
16. A pipe of diameter 20 cm and length 2000 m is connects two reservoirs, having difference of water levels as 20 m. determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take f = 0.015 and neglect minor losses.
17. A pipe line 60 cm diameter bifurcates at a Y- junction into two branches 40 cm and 30 cm in diameter. If the rate of flow in the main pipe is 1.5 m3 /s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s, determine the rate of flow in the 40 cm diameter pipe.
18. A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 N/ cm2 . Take f = 0.0065.
19. Find the maximum power transmitted by a jet of water discharging freely out of nozzle fitted to a pie = 300 m long and 100 mm diameter with co efficient of friction as 0.01. the available head at the nozzle is 90 m.

**UNIT – V-DIMENSIONAL ANALYSIS AND SIMILITUDE MODEL**

**PART-A**

**EACH QUESTION CARRIES 2 MARKS**

1. Define the term Fundamental dimensions or fundamental quantity?
2. What is Dimensional analysis?
3. Define Model Analysis.
4. What is model and Prototype?
5. List out different types of similarity exists model and protype.
6. How hydraulic models are classified?
7. Define Reynold’s number.
8. Define Froude’s number.
9. Define Model laws or similarity laws.
10. What is scale ratio?
11. Explain the term the dimensionally Homogeneous equation.
12. What is Mach number?

**PART-B**

**EACH QUESTION CARRIES 4 MARKS**

1. Determine the dimensions for the following quantities.
2. Force and (ii) Kinematic viscosity
3. Define Buckingham π –Theorme. Discuss about its method of selection repeating variables.
4. Discuss about scale ratios for Distorted models.
5. Define similitude and discuss about types of similarities.
6. Discuss about Model laws or similarity laws.
7. Give the dimensions of Area and Volume.
8. Derive the dimensions of velocity.
9. Define Model. And List out the advantages of model analysis.
10. Define similitude. And Define Scale ratio.
11. Define dynamic similarity and Give the types of forces in a moving fluid.
12. Define dimensionless numbers and Give the types of dimensionless numbers.
13. Define surface tension,pressure force and Elastic force.
14. Give the classification of models.
15. What is an undistorted model?
16. What id distorted model?
17. Give the advantages of distorted models.
18. List out the types of model laws.
19. List out the application of Froude’s model laws.
20. 24. Define Weber’s model laws.

**PART-C**

**EACH QUESTION CARRIES 14 MARKS**

1. The time period (t), of a pendulum depends upon the length (L) of the pendulum and acceleration due to gravity (g). Derive an expression for the time period using Rayleigh’s method.
2. The pressure difference ∆p in a pipe diameter D and length l due to turbulent flow depends on the velocity V, viscosity µ, density ρ and roughness k. using Buckingham π-theorem. Obtain expression for ∆p.
3. Define the following dimensionless numbers
4. Reynold’s Number
5. Froude’s Number
6. Euler’s Number
7. Weber’s Number
8. Mach Number
9. Explain Buckingham’s theorem.
10. The resisting force (R) of a supersonic flight can be considered as dependent upon length of aircraft (l), velocity (V), air viscosity ‘μ’, air density ‘ρ’, and bulk modulus of air ‘ k’. Express the functional relationship between these variables and the resisting force.
11. 3. A ship is 300 m long moves in sea water, whose density is 1030 kg/m3 . A 1:100 model of this to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60 N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m3 . Take the Kinematic viscosity of sea water and air as 0.012 stokes and 0.018 stokes respectively.
12. A 7.2 m height and 15 m long spillway discharge 94 m3 /s, under a head of 2.0m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experience a force of 7500 N (764.53 Kgf), determine force on the prototype.
13. A quarter scale turbine model is tested under ahead of 12 m. The full scale turbine is to work under a head of 30 m and to run at 428 rpm. Find N for model. If model develops 100 kW and uses 1100 l/s at this speed, what power will be obtained from full scale turbine assuming its n is 3% better than that of model.
14. Using Buckingham’s π theorem, show that the drag force FD = ρ L2 V2 φ (Re,M) which Re = ρ LV/μ; M = V/C; ρ = fluid mass density; L = chord length: V= velocity of aircraft; μ = fluid viscosity; C = sonic velocity = √K/ ρ where K = bulk modulus of elasticity.
15. The resistance ‘ R’ experienced by apartially, submerged body depends upon the velocity ‘V’, length of the body ‘l’, viscosity of fluid ‘μ’, density of the fluid ‘ρ’, and gravitational acceleration ‘g’; obtain expression for R.
16. Derive the relation using Buckingham’s π theorem F = ρ U2 D2 f (μ/UD ρ), ND/U).
17. State the reasons for construction distorted model of rivers and discuss the various types of distortion in models. What are the merits and demerits of distorted models as compared to undistorted model?
18. In an aeroplane model of size 1/10 of its prototype the pressure drop is 7.5 kN/m3 . The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air is 1.4 kg/ m3 , density of water is 1000 kg/ m3 , viscosity of air is 0.00018 poise and viscosity of water is 0.01 poise.