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2 MARKS WITH ANSWERS - COMPLETE NOTES

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

PART-A

1. Define density or mass density. (May/June2013)

Density of a fluid is defined as the ratio of the mass of a fluid to its volume.

Density, ρ = mass/volume (Kg/m^3)

$\rho_{water} = 1000\ Kg/m^3$

2. Define specific weight or weight density. (May/June2013)

Specific weight or weight density of a fluid is defined as the ratio between the weight of a fluid to its volume.

Specific weight, γ = weight/volume (N/m^3)

$\gamma = \rho g$

$\gamma_{water} = 9810\ N/m^3$

3. Define specific volume. (May/June 2012)

Specific volume of a fluid is defined as the volume of fluid occupied by an unit wt or unit mass of a fluid.

Specific volume vs = volume/ wt = $1/\gamma = 1/\rho g$ ----- for liquids

Specific volume vs = volume/ mass = $1/\rho$ ----- for gases .

4. Define dynamic viscosity. (Nov/Dec 2010)

Viscosity is defined as the property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of the fluid.

$$\zeta = \mu \frac{du}{dy}$$

μ – dynamic viscosity or viscosity or coefficient of viscosity ($N\text{-}s/m^2$)

$1\ N\text{-}s/m^2 = 1\ Pa\text{-}s = 10$ Poise

5. Define Kinematic viscosity. (Nov/Dec 2011,14)

It is defined as the ratio between the dynamic viscosity and density of fluid.

$\nu = \mu/\rho\ (m^2/s)$

$1\ m^2/s = 10000$ Stokes (or) 1 stoke $= 10^{-4}\ m^2/s$

6. Types of fluids. (May/June2012)

Ideal fluid, Real fluid, Newtonian fluid, Non-Newtonian fluid, Ideal Plastic fluid.

7. Define Compressibility. (May/June 2013)

It is defined as the ratio of volumetric strain to compressive stress.

Compressibility, β = (d Vol/ Vol) / dp (m^2/N)

8. Define Surface Tension. (May/June 2013)

Surface tension is defined as the tensile force acting on the surface of the liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behaves like a membrane under tension.

Surface Tension, σ = Force/Length (N/m)

$\sigma_{water} = 0.0725\ N/m$ $\sigma_{Mercury} = 0.52\ N/m$

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9. Surface tension. (Nov/Dec 2013), (May/June 2014)

Surface tension on liquid droplet, $\sigma = pd/4$

Surface tension on a hollow bubble, $\sigma = pd/8$

Surface tension on a liquid jet, $\sigma = pd/2$

σ – surface tension (N/m)

d – diameter (m)

p – pressure inside (N/m^2)

$p_{total} = p_{inside} + p_{atm}$ $p_{atm} = 101.325 \times 10^3 \ N/m^2$

10. Define Capillarity. (Nov/Dec 2013)

Capillarity is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known as capillary rise while the fall of liquid surface is known as capillary depression.

Capillary Rise or fall, $h = (4\sigma \cos\theta) / \rho g d$

$\theta = 0$ for glass tube and water $\theta = 130^o$ for glass tube and mercury

11. Define Vapour Pressure.

When vaporization takes place, the molecules start accumulating over the free liquid surface exerting pressure on the liquid surface. This pressure is known as Vapour pressure of the liquid.

12. Define Control Volume. (May/June2012)

A control volume may be defined as an identified volume fixed in space. The boundaries around the control volume are referred to as control surfaces. An open system is also referred to as a control volume.

13. Write the continuity equation. (Nov/Dec 2013)

The equation based on the principle of conservation of mass is called continuity equation.

$\delta u/\delta x + \delta v/\delta y + \delta w/\delta z = 0$ ----- three dimensional flow

$\delta u/\delta x + \delta v/\delta y = 0$ ----- two dimensional flow

$Q = a_1 v_1 = a_2 v_2$ ----- one dimensional flow

14. List the types of fluid flow. (May/June 2014)

Steady and unsteady flow, Uniform and non-uniform flow, Laminar and Turbulent flow

Compressible and incompressible flow, Rotational and ir-rotational flow, One, Two and Three dimensional flow.

15. Define Steady and Unsteady flow. (May/June 2014)

Steady flow

Fluid flow is said to be steady if at any point in the flowing fluid various characteristics such as velocity, density, pressure,etc do not change with time.

$\partial V/\partial t = 0$ $\partial p/\partial t = 0$ $\partial \rho/\partial t = 0$

Unsteady flow

Fluid flow is said to be unsteady if at any point flowing fluid any one or all characteristics which describe the behaviour of the fluid in motion change with time.

$\partial V/\partial t \neq 0$ $\partial p/\partial t \neq 0$ $\partial \rho/\partial t \neq 0$

16. Define Uniform and Non-uniform flow.

Uniform flow

When the velocity of flow of fluid does not change both in direction and magnitude from point to point in the flowing fluid for any given instant of time, the flow is said to be uniform.

$\partial V/\partial s = 0$ $\partial p/\partial s = 0$ $\partial \rho/\partial s = 0$

Non-uniform flow

If the velocity of flow of fluid changes from point to point in the flowing fluid at any instant, the flow is said to be non-uniform flow.

$\partial V/\partial s \neq 0$ $\partial p/\partial s \neq 0$ $\partial \rho/\partial s \neq 0$

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17. Compare Laminar and Turbulent flow.

Laminar and Turbulent flow

A flow is said to be laminar if Reynolds number is less than 2000 for pipe flow. Laminar flow is possible only at low velocities and high viscous fluids. In laminar type of flow, fluid particles move in laminas or layers gliding smoothly over the adjacent layer.

Turbulent flow

In Turbulent flow, the flow is possible at both velocities and low viscous fluid. The flow is said to be turbulent if Reynolds number is greater than 4000 for pipe flow. In Turbulent type of flow fluid, particles move in a zig – zag manner.

18. Define Compressible and incompressible flow.

Compressible flow

The compressible flow is that type of flow in which the density of the fluid changes from point to point i.e. the density is not constant for the fluid. It is expressed in kg/sec.

$\rho \neq$ **constant**

Incompressible flow

The incompressible flow is that type of flow in which the density is constant for the fluid flow. Liquids are generally incompressible. It is expressed in m^3/s.

$\rho =$ **constant**

19. Define Rotational and Ir-rotational flow.

Rotational flow

Rotational flow is that type of flow in which the fluid particles while flowing along stream lines and also rotate about their own axis.

Ir-rotational flow

If the fluid particles are flowing along stream lines and do not rotate about their own axis that type of flow is called as ir-rotational flow

20. Define One, Two and Three dimensional flow.

One dimensional flow

The flow parameter such as velocity is a function of time and one space co-ordinate only. $u = f(x), v = 0$ & $w = 0$.

Two dimensional flow

The velocity is a function of time and two rectangular space co-ordinates. $u = f_1(x, y), v = f_2(x, y)$ & $w = 0$.

Three dimensional flow

The velocity is a function of time and three mutually perpendicular directions.

$u = f_1(x, y, z), v = f_2(x, y, z)$ & $w = f_3(x, y, z)$.

21. Write the Bernoulli's equation applied between two sections.

$$p_1/\rho g + v_1^2/2g + Z_1 = p_2/\rho g + v_2^2/2g + Z_2$$

$p/\rho g$ = pressure head

$v^2/2g$ = kinetic head

Z = datum head

22. State the assumptions used in deriving Bernoulli's equation.

Flow is steady; Flow is laminar; Flow is irrotational;

Flow is incompressible; Fluid is ideal.

23. Write the Bernoulli's equation applied between two sections with losses.

$$p_1/\rho g + v_1^2/2g + Z_1 = p_2/\rho g + v_2^2/2g + Z_2 + h_{loss}$$

24. List the instruments works on the basis of Bernoulli's equation.

Venturi meter; Orifice meter; Pitot tube.

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25. Define Impulse Momentum Equation (or) Momentum Equation.

The total force acting on fluid is equal to rate of change of momentum. According to Newton's second law of motion, **F = ma**

F dt = d(mv)

26. Write the expression for loss of head at the entrance of the pipe.

$h_i = 0.5V^2/2g$

h_i = Loss of head at entrance of pipe. V = Velocity of liquid at inlet of the pipe.

27. Write the expression for loss of head at exit of the pipe.

$h_o = V^2/2g$

Where, h_o = Loss of head at exit of the pipe.

V = Velocity of liquid at inlet and outlet of the pipe.

28. Give an expression for loss of head due to an obstruction in pipe. (May/June 2013)

Loss of head due to an obstruction = $V^2 / 2g\ (A/\ Cc\ (A-a) -1)^2$

Where, A = area of pipe, a = Max area of obstruction,

V = Velocity of liquid in pipe A-a = Area of flow of liquid

29. What is compound pipe or pipes in series?

When the pipes of different length and different diameters are connected end to end, then the pipes are called as compound pipes or pipes in series.

30. What is mean by parallel pipe? and write the governing equations. (Nov/Dec 2011)

When the pipe divides into two or more branches and again join together downstream to form a single pipe then it is called as pipes in parallel. The governing equations are:

$Q_1 = Q_2 + Q_3\ h_{f1} = h_{f2}$

PART-B

1. State Bernoulli's theorem and assumptions for steady flow of an incompressible fluid. (May/June 2013)

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

2. The space between two square flat parallel plate is filled with oil. Each side of the plate is 600mm. The thickness of the oil films is 12.5mm. The upper plate, which moves at 2.5m /s, requires a force of 98.1 N to maintain the speed. Determine

(i) The dynamic viscosity of the oil in poise.

(ii) The kinematic viscosity of the oil in strokes if the specific gravity of the oil is 0.95.

(May/June 2013)

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", Page No from 6 to 7 and from 10 to 11.

3. A U-tube is made of two capillaries of diameter 1mm and 1.5mm respectively. The tube is kept vertically and partially filled with water of surface tension 0.0736 N/m and zero contact angle. Calculate the difference in the levels of the menisci caused by the capillary.

(May/June 2012)

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", Page No from 6 to 7 and from 10 to 11.

4. A pipe line 60cm in diameter bifurcates at a Y-junction into two branches 40cm and 30cm in diameter. If the rate of flow in the main pipe is 1.5m^3/s and the mean velocity of flow in the 30cm pipe is 7.5m/s. Determine the rate of flow in the 40cm pipe. (May/June 2012)

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11

5. Explain in detail the Newton's law of viscosity. Briefly classify the fluids based on the density and viscosity. Give the limitations of applicability of Newton's law of viscosity. (May/June 2014)

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11

6. Derive energy equations and state the assumptions made while deriving the equations.May/June 2014)

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Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11

UNIT II FLOW THROUGH CIRCULAR CONDUITS

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram-commercial pipes- minor losses – Flow through pipes in series and parallel.

PART-A

1. Mention the range of Reynold's number for laminar and turbulent flow in a pipe. (May/June 2014)

If the Reynold's number is less than 2000, the flow is laminar. But if the Reynold's number is greater than 4000, the flow is turbulent flow.

2. What does Haigen-Poiseulle equation refer to? (Nov/Dec 2011)

The equation refers to the value of loss of head in a pipe of length 'L' due to viscosity in a laminar flow.

3. What is Hagen poiseuille's formula? (May/June 2012)

$$(P_1-P_2) / \rho g = h_f = 32\, \mu \bar{U} L / \rho g D^2$$

The expression is known as Hagen poiseuille formula.

Where $P_1-P_2 / \rho g$ = Loss of pressure head, $\bar{U}$= Average velocity,

μ = Coefficient of viscosity, D = Diameter of pipe,

L = Length of pipe

4. Write the expression for shear stress? (Nov/Dec 2012)

Shear stress $\zeta = - (\partial p/\partial x)\, (r/2)$

$\zeta_{max} = - (\partial p/\partial x)\, (R/2)$

5. Give the formula for velocity distribution: - (Nov/Dec 2012)

The formula for velocity distribution is given as

$$u = - (1/4\mu)\, (\partial p/\partial x)\, (R^2 - r^2)$$

Where R = Radius of the pipe, r = Radius of the fluid element

6. Give the equation for average velocity : - (May/June 2013)

The equation for average velocity is given as

$$\bar{U} = - (1/8\mu)\, (\partial p/\partial x)\, R^2$$

Where R = Radius of the pipe

7. Write the relation between Umax and Ū? (May/June 2013)

$$U_{max} / \bar{U} = \{ - (1/4\mu)\, (\partial p/\partial x)\, R^2 \} / \{ - \tfrac{1}{8}\mu\, (\partial p/\partial x)\, R^2 \}$$

$$U_{max} / \bar{U} = 2$$

8. Give the expression for the coefficient of friction in viscous flow? (Nov/Dec 2013)

Coefficient of friction between pipe and fluid in viscous flow **f =16/ Re**

Where, f = Re = Reynolds number

9. What are the factors to be determined when viscous fluid flows through the circular pipe? (Nov/Dec 2013)

The factors to be determined are:

i. Velocity distribution across the section.

ii. Ratio of maximum velocity to the average velocity.

iii. Shear stress distribution.

iv. Drop of pressure for a given length.

10. Define kinetic energy correction factor.

Kinetic energy factor is defined as the ratio of the kinetic energy of the flow per sec based on actual

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velocity across a section to the kinetic energy of the flow per sec based on average velocity across the same section. It is denoted by (α).

K. E factor (α) = K.E per sec based on actual velocity / K.E per sec based on Average velocity

11. Define momentum correction factor (β):

It is defined as the ratio of momentum of the flow per sec based on actual velocity to the momentum of the flow per sec based on average velocity across the section.

β= Momentum per sec based on actual velocity/Momentum Per sec based on average velocity

12. Define Boundary layer.

When a real fluid flow passed a solid boundary, fluid layer is adhered to the solid boundary. Due to adhesion fluid undergoes retardation thereby developing a small region in the immediate vicinity of the boundary. This region is known as boundary layer.

13. What is mean by boundary layer growth?

At subsequent points downstream of the leading edge, the boundary layer region increases because the retarded fluid is further retarded. This is referred as growth of boundary layer.

14. Classification of boundary layer.

(i) Laminar boundary layer, (ii) Transition zone, (iii) Turbulent boundary layer.

15. Define Laminar boundary layer.

Near the leading edge of the surface of the plate the thickness of boundary layer is small and flow is laminar. This layer of fluid is said to be laminar boundary layer.

The length of the plate from the leading edge, upto which laminar boundary layer exists is called as laminar zone. In this zone the velocity profile is parabolic.

16. Define transition zone.

After laminar zone, the laminar boundary layer becomes unstable and the fluid motion transformed to turbulent boundary layer. This short length over which the changes taking place is called as transition zone.

17. Define Turbulent boundary.

Further downstream of transition zone, the boundary layer is turbulent and continuous to grow in thickness. This layer of boundary is called turbulent boundary layer. .

18. Define Laminar sub Layer. (May/June 2013)

In the turbulent boundary layer zone, adjacent to the solid surface of the plate the velocity variation is influenced by viscous effects. Due to very small thickness, the velocity distribution is almost linear. This region is known as laminar sub layer.

19. Define Boundary layer Thickness.

It is defined as the distance from the solid boundary measured in y-direction to the point, where the velocity of fluid is approximately equal to 0.99 times the free stream velocity (U) of the fluid. It is denoted by δ.

20. List the various types of boundary layer thickness.

Displacement thickness(δ*), Momentum thickness(θ), Energy thickness(δ**)

21. Define displacement thickness.

The displacement thickness (δ) is defined as the distance by which the boundary should be displaced to compensate for the reduction in flow rate on account of boundary layer formation.

$$\delta^* = \int [\,1 - (u/U)\,]\,dy$$

22. Define momentum thickness. (May/June 2013)

The momentum thickness (θ) is defined as the distance by which the boundary should be displaced to compensate for the reduction in momentum of the flowing fluid on account of boundary layer formation.

$$\theta = \int [\,(u/U) - (u/U)^2\,]\,dy$$

23. Define energy thickness.

The energy thickness (δ**) is defined as the distance by which the boundary should be displaced to compensate for the reduction in kinetic energy of the flowing fluid on account of boundary layer formation.

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$\delta^{**} = \int [(u/U) – (u/U)^3] dy$
24. What is meant by energy loss in a pipe? When the fluid flows through a pipe, it looses some energy or head due to frictional resistance and other reasons. It is called energy loss. The losses are classified as; Major losses and Minor losses.
25. Explain the major losses in a pipe. The major energy losses in a pipe is mainly due to the frictional resistance caused by the shear force between the fluid particles and boundary walls of the pipe and also due to viscosity of the fluid.
26. Explain minor losses in a pipe. The loss of energy or head due to change of velocity of the flowing fluid in magnitude or direction is called minor losses. It includes: sudden expansion of the pipe, sudden contraction of the pipe, bend in a pipe, pipe fittings and obstruction in the pipe, etc.
27. State Darcy-Weisbach equation OR What is the expression for head loss due to friction? $h_f = 4flv^2 / 2gd$ where, h_f = Head loss due to friction (m), L = Length of the pipe (m), d = Diameter of the pipe (m), V = Velocity of flow (m/sec) f = Coefficient of friction
28. What are the factors influencing the frictional loss in pipe flow? Frictional resistance for the turbulent flow is, i. Proportional to v^n where v varies from 1.5 to 2.0. ii. Proportional to the density of fluid. iii. Proportional to the area of surface in contact. iv. Independent of pressure. v. Depend on the nature of the surface in contact.
29. Write the expression for loss of head due to sudden enlargement of the pipe. $h_{exp} = (V_1 - V_2)^2 /2g$ Where, h_{exp} = Loss of head due to sudden enlargement of pipe. V_1 = Velocity of flow at pipe 1; V_2 = Velocity of flow at pipe 2.
30. Write the expression for loss of head due to sudden contraction. (May/June 2012) $h_{con} = 0.5\ V^2/2g$ h_{con} = Loss of head due to sudden contraction. V = Velocity at outlet of pipe.
PART-B& PART-C
1. Explain the losses of energy in flow through pipes. *Refer: ““Dr.R.KBANSAL, “Fluid Mechanics and Machinery”, ”, Page No from 6 to 7 and from 10 to 11.*
2. For a town water supply, a main pipe line of diameter 0.4m 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 pipes is same as in the single main pipe, find the diameter of parallel pipe. Assume coefficient of discharge to be the same for all the pipes. *Refer: ““Dr.R.KBANSAL, “Fluid Mechanics and Machinery”, ”, Page No from 6 to 7 and from 10 to 11.*
3. For a flow a viscous fluid flowing through a circular pipe under laminar flow conditions show that the velocity distribution is a parabola. And also show that the average velocity is half of the maximum velocity. (May/June 2012) *Refer: ““Dr.R.KBANSAL, “Fluid Mechanics and Machinery”, ”, Page No from 6 to 7 and from 10 to 11.*
4. A horizontal pipe line is 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300mm. The height of water level in the tank is 8m above the

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Centre of the pipe. Considering all losses of head which is occur, determine the rate of flow. Take f=0.01 for both sections of the pipe. (May/June 2012)   *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
5. Oil with a density of 900kg/m3 and kinematic viscosity of 6.2 X 10-4 m2/s is being discharged by a 6mm diameter, 40 m long horizontal pipe from a storage tank open to the atmosphere. The height of the liquid level above the center of the pipe is 3m. Neglecting the minor losses, determine the flow rate of oil through the pipe. (Nov/Dec 2012)   *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
6. Two pipes of diameter 40 cm and 20 cm are each 300 m long. When the pipes are connected in series and discharge through the pipe line is 0.10 m3/sec, find the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel? Take f = 0.0075 for each pipe. (Nov/Dec 2012)   *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*

UNIT III DIMENSIONAL ANALYSIS

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

PART-A

1. Define dimensional analysis. (Nov/Dec 2013)

Dimensional analysis is a mathematical technique which makes use of the study of dimensions as an aid to solution of several engineering problems. It plays an important role in research work.

2. Write the uses of dimension analysis. (May/June 2012)

- It helps in testing the dimensional homogeneity of any equation of fluid motion.
- It helps in deriving equations expressed in terms of non-dimensional parameters.
- It helps in planning model tests and presenting experimental results in a systematic manner.

3. List the primary and derived quantities. (May/June 2012)

Primary or Fundamental quantities: The various physical quantities used to describe a given phenomenon can be described by a set of quantities which are independent of each other. These quantities are known as fundamental quantities or primary quantities. Mass (M), Length (L), Time (T) and Temperature (θ) are the fundamental quantities.

Secondary or Derived quantities: All other quantities such as area, volume, velocity, acceleration, energy, power, etc are termed as derived quantities or secondary quantities because they can be expressed by primary quantities.

4. Write the dimensions for the followings. (May/June 2012)

Dynamic viscosity (μ) – $ML^{-1}T^{-2}$, Force (F) - MLT^{-2},

Mass density (ρ) – ML^{-3}, Power (P) -$ML^{2}T^{-3}$

5. Define dimensional homogeneity. (Nov/Dec2012)

An equation is said to be dimensionally homogeneous if the dimensions of the terms on its LHS are same as the dimensions of the terms on its RHS.

6. Mention the methods available for dimensional analysis. (Nov/Dec2012)

Rayleigh method, Buckinghum π method

7. State Buckingham's π theorem. May/June 2013)

It states that "if there are 'n' variables (both independent & dependent variables) in a physical phenomenon and if

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these variables contain 'm' functional dimensions and are related by a dimensionally homogeneous equation, and then the variables are arranged into n-m dimensionless terms. Each term is called π term".
8. List the repeating variables used in Buckingham π theorem. (May/June 2013) Geometrical Properties – l, d, H, h, etc, Flow Properties – v, a, g, ω, Q, etc, Fluid Properties – ρ, μ, γ, etc.
9. Define model and prototype. The small scale replica of an actual structure or the machine is known as its Model, while the actual structure or machine is called as its Prototype. Mostly models are much smaller than the corresponding prototype.
10. Write the advantages of model analysis. • Model test are quite economical and convenient. • Alterations can be continued until most suitable design is obtained. • Modification of prototype based on the model results. • The information about the performance of prototype can be obtained well in advance.
11. List the types of similarities or similitude used in model analysis. Geometric similarities, Kinematic similarities, Dynamic similarities
12. Define geometric similarities. It exists between the model and prototype if the ratio of corresponding lengths, dimensions in the model and the prototype are equal. Such a ratio is known as "Scale Ratio".
13. Define kinematic similarities. (May/June 2012) It exists between the model and prototype if the paths of the homogeneous moving particles are geometrically similar and if the ratio of the flow properties is equal.
14. Define dynamic similarities. It exits between model and the prototype which are geometrically and kinematically similar and if the ratio of all forces acting on the model and prototype are equal.
15. Mention the various forces considered in fluid flow. Inertia force, Viscous force, Gravity force, Pressure force, Surface Tension force, Elasticity force
16. Define model law or similarity law. The condition for existence of completely dynamic similarity between a model and its prototype are denoted by equation obtained from dimensionless numbers. The laws on which the models are designed for dynamic similarity are called Model laws or Laws of Similarity.
17. List the various model laws applied in model analysis. Reynold's Model Law, Froude's Model Law, Euler's Model Law, Weber Model Law, Mach Model Law
18. State Reynold's model law. For the flow, where in addition to inertia force the viscous force is the only other predominant force, the similarity of flow in the model and its prototype can be established, if the Renold's number is same for both the systems. This is known as Reynold's model law. $\mathbf{Re_{(p)} = Re_{(m)}}$
19. State Froude's model law. When the forces of gravity can be considered to be the only predominant force which controls the motion in addition to the force of inertia, the dynamic similarities of the flow in any two such systems can be established, if the Froude number for both the system is the same. This is known as Froude Model Law. $\mathbf{Fr_{(p)} = Fr_{(m)}}$
20. State Euler's model law. (May/June 2014) In a fluid system where supplied pressures are the controlling forces in addition to inertia forces and other forces are either entirely absent or in-significant the Euler's number for both the model and prototype which known as Euler Model Law.
21. State Weber's model law. When surface tension effect predominates in addition to inertia force then the dynamic similarity is obtained by

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equating the Weber's number for both model and its prototype, which is called as Weber Model Law.

22. State Mach's model law.

If in any phenomenon only the forces resulting from elastic compression are significant in addition to inertia forces and all other forces may be neglected, then the dynamic similarity between model and its prototype may be achieved by equating the Mach's number for both the systems. This is known Mach Model Law.

23. Classify the hydraulic models.

The hydraulic models are classified as: Undistorted model & Distorted model

24. Define undistorted model.

An undistorted model is that which is geometrically similar to its prototype, i.e. the scale ratio for corresponding linear dimensions of the model and its prototype are same.

25. Define distorted model.

Distorted models are those in which one or more terms of the model are not identical with their counterparts in the prototype.

26. Define Scale effect.

An effect in fluid flow that results from changing the scale, but not the shape, of a body around which the flow passes.

27. List the advantages of distorted model.

- The results in steeper water surface slopes and magnification of wave heights in model can be obtained by providing true vertical structure with accuracy.
- The model size can be reduced to lower down the cast.
- Sufficient tractate force can be developed to produce bed movement with a small model.

28. Write the dimensions for the followings.

Applications of FMS installations are in the following areas.

Quantities	Symbol	Unit	Dimension
Area	**A**	**m^2**	**L^2**
Volume	**V**	**m^3**	**L^3**
Angle	**A**	**Deg. Or Rad**	**$M^0L^0T^0$**
Velocity	**v**	**m/s**	**LT^{-1}**
Angular Velocity	**ω**	**Rad/s**	**T^{-1}**
Speed	**N**	**rpm**	**T^{-1}**
Acceleration	**a**	**m/s^2**	**LT^{-2}**
Gravitational Acceleration	**g**	**m/s^2**	**LT^{-2}**
Discharge	**Q**	**m^3/s**	**L^3T^{-1}**
Discharge per meter run	**q**	**m^2/s**	**L^2T^{-1}**
Mass Density	**ρ**	**Kg/m^3**	**ML^3**
Sp. Weight or Unit Weight	**N/m^3**	**$ML^{-2}T^{-2}$**	
Dynamic Viscosity	**μ**	**$N\text{-}s/m^2$**	**$ML^{-1}T^{-1}$**
Kinematic viscosity	**m^2/s**	**L^2T^{-1}**	
Force or Weight	**F or W**	**N**	**MLT^{-2}**
Pressure or Pressure intensity	**p**	**N/m^2 or Pa**	**$ML^{-1}T^{-2}$**
Modulus of Elasticity	**E**	**N/m^2 or Pa**	**$ML^{-1}T^{-2}$**
Bulk Modulus	**K**	**N/m^2 or Pa**	**$ML^{-1}T^{-2}$**
Workdone or Energy	**W or E**	**N-m**	**ML^2T^{-2}**

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Torque	**T**	**N-m**	**ML^2T^{-2}**
Power	**P**	**N-m/s or J/s or Watt**	**ML^2T^{-3}**

29. Give the benefits of FMS.

The benefits that can be expected from an FMS include

- Increased machine utilization
- Fewer machines required
- Reduction in factory floor space required
- ¨ Greater responsiveness to change
- Reduced inventory requirements
- 1ower manufacturing lead times
- Reduced direct labour requirements and higher labor productivity
- Opportunity for unattended production

30. List any two advantages and disadvantages of FMS implementation.

Advantages

- Faster, lower-cost changes from one part to another which will improve capital utilization.
- 1ower direct labor cost, due to the reduction in number of workers.

Disadvantages

- Substantial pre-planning activity.
- Expensive, costing millions of dollars.

31. How does FMS classified based on level of flexibility?

FMS classified based on level of flexibility as,

- Production flexibility
- Machine flexibility
- Mix flexibility
- Product flexibility

PART-B& PART-C

1. What are the significance and the role of the following parameters?

i. Reynold's number
ii. Froude number
iii. Mach number
iv. Weber number **(May/June 2013)**
v.

Refer: "Mikell "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

2. The resisting force F of a plane during flight can be considered as dependent upon the 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 using dimensional analysis. Explain the physical significance of the dimensionless groups arrived. (May/June 2013)

Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

3. The efficiency of a fan depends on density, viscosity of the fluid, angular velocity, diameter of rotor and discharge. Express in terms of NON-DIMENSIONAL PARAMETERS. Using Buckingham's theorem. (May/June 2012)

Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

4. A geometrically similar model of an air duct is built to 1/25 scale and tested with water which is 50 times more viscous and 800 times denser than air. When tested under dynamically similar conditions, the pressure

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drop is 200 kN/m^2 in the model. Find the corresponding pressure drop in the full scale prototype and express in cm of water. (May/June 2012)
Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

5. The power developed by hydraulic machines is found to depend on the head h, flow rate Q, density ρ , speed N, runner diameter D, and acceleration due to gravity g. Obtain suitable dimensionless parameters to correlate experimental results. (May/June 2014)
Refer: "Mikell "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

6.The capillary rise h is found to be influenced by the tube diameter D, density ρ , gravitational acceleration gand surface tension σ . Determine the dimensionless parameters for the correlation of experimental results. (May/June 2013)
Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

UNIT IV PUMPS

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

PART-A

1. What is meant by Pump? (Nov/Dec 2011)
A pump is device which converts mechanical energy into hydraulic energy.

2. Mention main components of Centrifugal pump. (Nov/Dec 2011)
i) Impeller ii) Casing
iii) Suction pipe,strainer & Foot valve iv) Delivery pipe & Delivery valve

3. What is meant by Priming? (May/June 2014)
The delivery valve is closed and the suction pipe, casing and portion of the delivery pipe upto delivery valve are completely filled with the liquid so that no air pocket is left. This is called as priming.

4. Define Manometric head. (May/June 2012)
It is the head against which a centrifugal pump work.

5. Define Mechanical efficiency.(May/June 2013)
It is defined as the ratio of the power actually delivered by the impeller to the power supplied to the shaft.

6. Define overall efficiency. (Nov/Dec 2012)
It is the ratio of power output of the pump to the power input to the pump.

7. Define speed ratio, flow ratio. (May/June 2013)
Speed ratio: It is the ratio of peripheral speed at outlet to the theoretical velocity of jet corresponding to manometric head.
Flow ratio: It is the ratio of the velocity of flow at exit to the theoretical velocity of jet corresponding to manometric head.

8. Mention main components of Reciprocating pump. (May/June 2013)
- Piton or Plunger
- Suction and delivery pipe
- Crank and Connecting rod

9. Define Slip of reciprocating pump. When the negative slip does occur? (May/june 2013)
The difference between the theoretical discharge and actual discharge is called slip of the pump. But in sometimes actual discharge may be higher then theoretical discharge, in such a case coefficient of discharge is greater then unity and the slip will be negative called as negative slip.

10. What is indicator diagram? (Nov/Dec 2013)
Indicator diagram is nothing but a graph plotted between the pressure head in the cylinder and the distance

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traveled by the piston from inner dead center for one complete revolution of the crank.

11. What is meant by Cavitations?

It is defined phenomenon of formation of vapor bubbles of a flowing liquid in a region where the pressure of the liquid falls below its vapor pressure and the sudden collapsing of theses vapor bubbles in a region of high pressure.

12. What are rotary pumps?

Rotary pumps resemble like a centrifugal pumps in appearance. But the working method differs. Uniform discharge and positive displacement can be obtained by using these rotary pumps, It has the combined advantages of both centrifugal and reciprocating pumps.

13. What is meant by NPSH?

The net positive suction head (NPSH), The minimum pressure required at the suction port of the pump to keep the pump from cavitating. NPSHA is a function of your system and must be calculated, whereas NPSHR is a function of the pump and must be provided by the pump manufacturer.

14. List the losses in centrifugal pump.

• Mechanical friction power loss due to friction between the fixed and rotating parts in the bearing and stuffing boxes.

• Disc friction power loss due to friction between the rotating faces of the impeller (or disc) and the liquid.

• Leakage and recirculation power loss. This is due to loss of liquid from the pump and recirculation of the liquid in the impeller. The pressure difference between impeller tip and eye can cause a recirculation of a small volume of liquid, thus reducing the flow rate at outlet of the impeller.

15. Mention main components of Centrifugal pump.

i) Impeller ii) Casing

iii) Suction pipe, strainer & Foot valve iv) Delivery pipe & Delivery valve

16. Mention main components of Reciprocating pump.

`# Piton or Plunger

Suction and delivery pipe

Crank and Connecting rod

17. What is the role of process planning in CIM architecture?

The process planning function can ensure the profitability or non profitability of a part being manufactured because of the myriad ways in which a part can be produced.

18. What is dispatching?

Dispatching is the function of releasing all required items needed to perform an operation on a part so that part production may be accomplished at the time planned by the scheduling function.

19. What about shop-floor information?

Shop-floor information system is responsible for getting the required information down to the processing equipment local controllers and sequencing controllers as well as capturing real-time status data from the equipment and parts so that the feedback loops can effect corrections or normal continuation of operation as required.

20. Explain PDM.

Product Data Management (PDM) or Product Information Management (PIM) systems provide the tools to control access to and manage all product definition date. It does this by maintaining information (meta-data) about product information. Product Data Management (PDM) systems, when tightly integrated with other product development tools does this transparently and with minimal additional effort on the part of the user.

21. List different types of production monitoring system.

Three types production/ process monitoring systems are:

- Data acquisition systems
- Data logging system

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- Multilevel scanning

22. What are the inputs to MRP system? (May/June 2012)

- Master production schedule
- Bill of material file
- Inventory record file

23.Write down three phases of shop floor control.(Nov/Dec 2012)

(i) Order release,
(ii) Order scheduling
(iii) Order progress

24.What is meant by procurement lead time?(Nov/Dec 2012)

The procurement lead time is the interval (usually in months) between the initiation of procurement action and the receipt into the supply system of the material produced.

25. What is meant by fixed order quantity model? (Nov/Dec 2013)

In fixed order quantity model, the size of the order (i,e, order quantity) is predetermined fixed, but the time of its placement (i.e, ordering time) is allowed to vary depending upon the fluctuation of demand.

26. What is foreign key?

A key used in one table to represent the value of a primary key in a related table. While primary keys must contain unique values, foreign keys may have duplicates. For instance, if we use student ID as the primary key in a Students table (each student has a unique ID), we could use student ID as a foreign key.

27. What is normalization?

The process of structuring data to minimize duplication and inconsistencies. The process usually involves breaking down a single table into two or more tables and defining relationships between those tables. Normalization is usually done in stages, with each stage applying more rigorous rules to the types of information which can be stored in a table.

28. Mention the different levels of data modelling.

The Data structures are created within a database. The extent of the relationships among them, plays an important role in determining the effectiveness of DBMS. Therefore the database design becomes a crucial activity in the database environment. The task of Database design is made simpler when data models are used. Models are "Simplified abstractions of real-world events or conditions".

For example, such abstractions will enable us to explore the characteristics of entities and the relationships that can be created among such entities. If the models are not logically sound, the database designs derived from them will not deliver the database system's promise of effective information drawn from an efficient database.

29. What is Network Data Model?

A network data model is simply a graph wherein nodes represent unique records, and links between nodes represent association between the corresponding records.

30. What is Hierarchical Data Model?

The hierarchical data model is similar to the network data model except that the relationships among the records are represented in the form of tree structure.

PART-B& PART-C

1. Explain the working principle of single and double acting reciprocating pumps, centrifugal pump with neat diagram in detail. Also explain the effects of inertia pressure and friction on the performance of the pump using indicator diagrams with and without air vessel.

Refer: "Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

2. Explain the working principle of screw pump, gear pump, lobe pump, and vane pump.

.Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

3. A single acting reciprocatory pump has a plunger of diameter 30cm and stroke of 20cm. If the speed of the pumps is 30rpm and it delivers 6.5lit/s of water, find the coefficient of discharge and the percentage slip of the pump.

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Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.
4. Explain about indicator diagram & characteristic curves of pumps with neat sketch. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
5. A centrifugal pump with an impeller diameter of 0.4m runs at 1450rpm. The angle at outlet of the backward curved vane is 25° with tangent. The flow velocity remains constant at 3m/s. If the manometric efficiency is 84%. Determine the fraction of the kinetic energy at outlet recovered as static head. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
5. Explain the working principle of double acting reciprocating pump. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*

UNIT V TURBINES

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

PART-A

1. Define hydraulic machines.
Hydraulic machines which convert the energy of flowing water into mechanical Energy

2. Give example for a low head, medium head and high head turbine.
Low head turbine – Kaplan turbine
Medium head turbine – Modern Francis turbine
High head turbine – Pelton wheel

3. What is impulse turbine? Give example. (May/june 2012)
In impulse turbine all the energy converted into kinetic energy. From these the turbine will develop high kinetic energy power. This turbine is called impulse turbine. **Example:** Pelton turbine

4. What is reaction turbine? Give example.(May/June 2014)
In a reaction turbine, the runner utilizes both potential and kinetic energies. Here portion of potential energy is converted into kinetic energy before entering into the turbine. Example: Francis and Kaplan turbine.

5. What is axial flow turbine? (May/June 2014)
In axial flow turbine water flows parallel to the axis of the turbine shaft. Example: Kaplan turbine

6. What is mixed flow turbine? (Nov/Dec 2013)
In mixed flow water enters the blades radially and comes out axially, parallel to the turbine shaft. Example: Modern Francis turbine.

7. What is the function of spear and nozzle? (May/June 2014)
The nozzle is used to convert whole hydraulic energy into kinetic energy. Thus the nozzle delivers high speed jet. To regulate the water flow through the nozzle and to obtain a good jet of water spear or nozzle is arranged.

8. Define gross head and net or effective head. (Nov 2012)
Gross Head: The gross head is the difference between the water level at the reservoir and the level at the tailstock.
Effective Head: The head available at the inlet of the turbine.

9. Define hydraulic efficiency.
It is defined as the ratio of power developed by the runner to the power supplied by the water jet.

10. Define mechanical efficiency. (May/June 2013)
It is defined as the ratio of power available at the turbine shaft to the power developed by the turbine runner.

11. Define volumetric efficiency.
It is defined as the volume of water actually striking the buckets to the total water supplied by the jet.

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12. Define overall efficiency.

It is defined as the ratio of power available at the turbine shaft to the power available from the water jet.

13. State Euler turbine equation.

The equation is based on the concepts of conservation of angular momentum and conservation of energy.

14. What are the methods of robot programming? (or) List out four methods of entering commands into the robot controller memory. (Nov 2014)

- On-line programming
- Lead through programming
- Textual robot languages
- Walk-through programming
- Mechanical programming
- Task programming
- Off-line programming

15. What are the ways of accomplishing lead through programming?

- Powered Lead through
- Manual Lead through

16. What are the components of DDC? (Nov/Dec 2011)

- Transducer , sensors, and associated instrumentation
- Actuators (process interface devices)
- Digital computer
- Analog to digital convertor (ADC)
- Digital to analog convertor (DAC)
- Input and output multiplexers

17. What is direct digital control? Nov/Dec 2013

Direct digital control is a computer process control system in which certain components in a conventional analog control system are replaced by the digital computer.

18. Describe CIM data transmission methods.

- The transmission of binary data across a link can be accomplished either in parallel mode or serial mode,
- In parallel mode multiple data are sent with each clock pulse, while, in serial method , one bit is sent with each clock pulse.

19. What are the two types of channel?

Two basic channel types are used in data communications. They are

i) Analog type ii) Digital type

20. List the characteristics of channel.

The channel characteristics are

i) Electronic noise ii) Signal attenuation

iii) Analog channel capacity iv) Digital channel capacity

21. What is channel bandwidth?

An analog signal can vary from a minimum to maximum frequency. The di (Terence between the lowest and the highest frequency of a single analog is the bandwidth of that signal. The mathematical formula for frequency is,

$$\text{Frequency} = \frac{\text{Velocity}}{\text{Wavelength}}$$

22. What are two types of transmission mode?

There are three transmission modes available. They arc

i) Simplex ii) Half-duplex iii) Duplex.

They can be applied to both analog and digital channels.

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23. What is modulation?

The process of varying amplitude or frequency or phase of the carrier signal in accordance with the instantaneous value of the information signal is known as modulation.

24. What is demodulation?

The process of separating the original information signal from the modulated carrier signal is known as demodulation. It is the inverse process of modulation.

25. What are the reasons for using LAN?

1. LAN allows for decentralization of various data processing functions.
2 LAN allows departments to share hardware.
3. LAN allows for the electronic transfer of text.
4. LAN allows for communication between organizations.
5. LAN allows information to be shared.

26. What are the features of LAN?

i) Compatibility ii) Protected Mode Operation
iii) Internetworking iv) Growth Path and Modularity
v) System Reliability

27. Define topology and explain its classification.

The pattern of interconnection of nodes in a network is called topology. Topcigy can also be defined as the geometric arrangement of workstations and the links among them.
The types of LAN topology are i) Bus topology ii) Ring topology iii) Star topology iv) Mesh topology

28. What are the Advantages of LAN?

- LAN is suited to any type of application.
- It provides data integrity.
- Any number of users can be accommodated.
- A LAN can fit any site requirements.
- It is flexible and growth-oriented.
- LAN provides a cost-effective multi user computer environment.
- Data transfer rates are above 10 Mbps.
- It all lows sharing of mass central storage and printers.
- It allows file/record locking.

29. Define OSI.

Open systems interconnection (OSI) reference model is an international standards organization (ISO) standard that specifies the conceptual structure of systems that are to communicate with each other.

30. List out the layers of OSI model.

Seven layers in OSI model
i) Physical layer
ii) Data link layer
iii) Network layer
iv) Transport layer
v) Session layer
vi) Presentation layer
vii) Application layer

PART-B& PART-C

1. 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 volume flow rate, H.P and Efficiency. (May/June 2013)

Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.

2. An inward flow reaction turbine having an overall efficiency of 80% is required to deliver 136kw. The head H is 16 m and the peripheral velocity is $3.3\sqrt{H}$. The radial velocity of flow at inlet is $1.1\sqrt{H}$.

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The runner rotates at 120rpm. The hydraulic losses in the turbine are 15% of the flow available energy. Determine (i) diameter of the runner (ii) guide vane angle (iii) the runner blade angle at inlet (iv) the discharge through the turbine. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
3. A kaplan turbine delivers 10 MW under a head of 25m. The hub and tip diameters are 1.2m and 3m. Hydraulic and overall efficiencies are 0.90 and 0.85. If both velocity triangles are right angled triangles, determine the speed, guide blade outlet angle and blade outlet angle. (May/June 2014) *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
4. Discuss characteristics curve, load efficiencies of turbines. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
5. Explain the working principle of reaction turbine. **(Nov/ Dec 2013)** *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*
6. Explain the working principle of impulse turbine. *Refer: ""Dr.R.KBANSAL, "Fluid Mechanics and Machinery", ", Page No from 6 to 7 and from 10 to 11.*

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