CE1211

SOLID AND FLUID MECHANICS

(Two Mark Question and Answers)

COMMON TO

B.E. II Yr Electronics & Instrumentation Engineering

AND

B.E. II Yr Electrical & Electronics Engineering

UNIT -1

1. Define stress.

When an external force acts on a body, it undergoes deformation. At the same time the body resists deformation. The magnitude of the resisting force is numerically equal to the applied force. This internal resisting force per unit area is called stress.

Stress = Force/Area

When a body is subjected to an external force, there is some change of dimension in the body. Numerically the strain is equal to the ratio of change in length to the original length of the body.= P/A unit is N/mm^2

2. Define strain

δ Strain = Change in length/Original length

$e = \delta L/L$

3. State Hooke's law.

It states that when a material is loaded, within its elastic limit, the stress is directly proportional to the strain.

Stress α Strain

$\sigma \alpha e$

$\sigma = Ee$

$E = \sigma/e$ unit is N/mm^2

Where,

E - Young's modulus

σ - Stress

e - Strain

4. Define shear stress and shear strain.

The two equal and opposite force act tangentially on any cross sectional plane of the body tending to slide one part of the body over the other part. The stress induced is called shear stress and the corresponding strain is known as shear strain.

5. Define Poisson's ratio.

When a body is stressed, within its elastic limit, the ratio of lateral strain to the longitudinal strain is constant for a given material.

Poisson' ratio (μ or 1/m) = Lateral strain /Longitudinal strain

6. State the relationship between Young's Modulus and Modulus of Rigidity.

$E = 2G (1+1/m)$

Where,

E - Young's Modulus

K - Bulk Modulus

1/m - Poisson's ratio

7. Define strain energy

Whenever a body is strained, some amount of energy is absorbed in the body. The energy which is absorbed in the body due to straining effect is known as strain energy.

8. Give the relationship between Bulk Modulus and Young's Modulus.

$$E = 3K(1-2/m)$$

Where,

E - Young's Modulus
K - Bulk Modulus
1/m - Poisson's ratio

9. What is compound bar?

A composite bar composed of two or more different materials joined together such that system is elongated or compressed in a single unit.

10. Define- elastic limit

Some external force is acting on the body, the body tends to deformation. If the force is released from the body its regain to the original position. This is called elastic limit

11. Define – Young's modulus

The ratio of stress and strain is constant with in the elastic limit.

$$E = \frac{\text{Stress}}{\text{Strain}}$$

12. Define Bulk-modulus

The ratio of direct stress to volumetric strain**.**

$$\mathbf{K = \frac{\text{Direct stress}}{\text{Volumetric strain}}}$$

13. Define- lateral strain

When a body is subjected to axial load P. The length of the body is increased. The axial deformation of the length of the body is called lateral strain.

13. Define- longitudinal strain

The strain right angle to the direction of the applied load is called lateral strain.

14. What is principle of super position?

The resultant deformation of the body is equal to the algebric sum of the deformation of the individual section. Such principle is called as principle of super position

15. Define- Rigidity modulus

The shear stress is directly proportional to shear strain.

$$N = \frac{\text{Shear stress}}{\text{Shear strain}}$$

16. State principle plane.

The planes, which have no shear stress, are known as principal planes. These planes carry only normal stresses.

17. Define principle stresses and principle plane.

Principle stress: The magnitude of normal stress, acting on a principal plane is known as principal stresses.

Principle plane: The planes which have no shear stress are known as principal planes.

18. What is the radius of Mohr's circle?

Radius of Mohr's circle is equal to the maximum shear stress.

19. What is the use of Mohr's circle?

To find out the normal, resultant stresses and principle stress and their planes.

20. List the methods to find the stresses in oblique plane?

1. Analytical method
2. Graphical method

UNIT –II

1. Define point of contra flexure? In which beam it occurs?

Point at which BM changes to zero is point of contra flexure. It occurs in overhanging beam.

2. What is mean by positive or sagging BM?

BM is said to positive if moment on left side of beam is clockwise or right side of the beam is counter clockwise.

3. What is mean by negative or hogging BM?

BM is said to negative if moment on left side of beam is counterclockwise or right side of the beam is clockwise.

4. Define shear force and bending moment?

SF at any cross section is defined as algebraic sum of all the forces acting either side of beam.

BM at any cross section is defined as algebraic sum of the moments of all the forces which are placed either side from that point.

5. When will bending moment is maximum?

BM will be maximum when shear force change its sign.

6. What is maximum bending moment in a simply supported beam of span 'L' subjected to UDL of 'w' over entire span

Max BM $=wL^2/8$

7. In a simply supported beam how will you locate point of maximum bending moment?

The bending moment is max. when SF is zero. Write SF equation at that point and equating to zero we can find out the distances 'x' from one end .then find maximum bending moment at that point by taking all moment on right or left hand side of beam.

8**. What is shear force?**

The algebric sum of the vertical forces at any section of the beam to the left or right of the section is called shear force.

9. What is shear force and bending moment diagram?

It shows the variation of the shear force and bending moment along the length of the beam.

10. What are the types of beams?

1. Cantilever beam
2. Simply supported beam
3. Fixed beam
4. Continuous beam

11. What are the types of loads?

1. Concentrated load or point load
2. Uniform distributed load
3. Uniform varying load

12.Draw the shear stress distribution diagram for a *I*–section.

13. In which point the bending moment is maximum?

When the shear force change of sign or the shear force is zero

14. Write the assumption in the theory of simple bending?

1. The material of the beam is homogeneous and isotropic.
2. The beam material is stressed within the elastic limit and thus obey hooke's law.
3. The transverse section which was plane before bending remains plains after bending also.
4. Each layer of the beam is free to expand or contract independently about the layer, above or below.
5. The value of E is the same in both compression and tension.

15. Write the theory of simple bending equation?

M/ I = F/Y = E/R

M - Maximum bending moment

I - Moment of inertia

F - Maximum stress induced

Y - Distance from the neutral axis

E - Young's modulus

R - Constant.

16. State the main assumptions while deriving the general formula for shear stresses

The material is homogeneous, isotropic and elastic

The modulus of elasticity in tension and compression are same.

The shear stress is constant along the beam width

The presence of shear stress does not affect the distribution of bending stress.

17. Define: Shear stress distribution

The variation of shear stress along the depth of the beam is called shear stress distribution

18. What is the ratio of maximum shear stress to the average shear stress for the rectangular section?

Q_{max} is 1.5 times the Q_{avg}.

19. What is the ratio of maximum shear stress to the average shear stress in the case of solid circular section?

Q_{max} is 4/3 times the Q_{ave}.

20. What is the shear stress distribution value of Flange portion of the I-section?

q= f/2I * (D2/4 - y)

D-depth

y- Distance from neutral axis

21. What is the value of maximum of minimum shear stress in a rectangular cross section?

Qmax=3/2 * F/ (bd)

22. Define Torsion

When a pair of forces of equal magnitude but opposite directions acting on body, it tends to twist the body. It is known as twisting moment or torsional moment or simply as torque.

Torque is equal to the product of the force applied and the distance between the point of application of the force and the axis of the shaft.

23. What are the assumptions made in Torsion equation

- The material of the shaft is homogeneous, perfectly elastic and obeys Hooke's law.
- Twist is uniform along the length of the shaft
- The stress does not exceed the limit of proportionality
- The shaft circular in section remains circular after loading
- Strain and deformations are small.

24. Define polar modulus

It is the ratio between polar moment of inertia and radius of the shaft.

£ = polar moment of inertia = $\frac{J}{R}$

Radius

25. Write the polar modulus for solid shaft and circular shaft.

£ = polar moment of inertia = $\frac{J}{R}$

Radius

$J = \frac{\pi D^4}{32}$

26. Why hollow circular shafts are preferred when compared to solid circular shafts?

- The torque transmitted by the hollow shaft is greater than the solid shaft.
- For same material, length and given torque, the weight of the hollow shaft will be less compared to solid shaft.

27. Write torsional equation

T/J=Cθ/L=q/R

T-Torque

J- Polar moment of inertia

C-Modulus of rigidity

L- Length

q- Shear stress

R- Radius

28. Write down the expression for power transmitted by a shaft

P=2πNT/60

N-speed in rpm

T-torque

29. Write down the expression for torque transmitted by hollow shaft

T= (π/16)*Fs*((D4-d4)/d4

T-torque

q- Shear stress

D-outer diameter

D- inner diameter

30. Write down the equation for maximum shear stress of a solid circular section in diameter 'D' when subjected to torque 'T' in a solid shaft.

T=π/16 * Fs*D3

T-torque

q Shear stress

D diameter

31. Define torsional rigidity

Product of rigidity modulus and polar moment of inertia is called torsional rigidity

32. What is composite shaft?

Some times a shaft is made up of composite section i.e. one type of shaft is sleeved over other types of shaft. At the time of sleeving, the two shaft are joined together, that the composite shaft behaves like a single shaft.

33. What is a spring?

A spring is an elastic member, which deflects, or distorts under the action of load and regains its original shape after the load is removed.

34. State any two functions of springs.

1 . To measure forces in spring balance, meters and engine indicators.

2 . To store energy.

35. What are the various types of springs?

i. Helical springs
ii. Spiral springs
iii. Leaf springs
iv. Disc spring or Belleville springs

36. Classify the helical springs.

1. Close – coiled or tension helical spring.
2. Open –coiled or compression helical spring.

37. What is spring index (C)?

The ratio of mean or pitch diameter to the diameter of wire for the spring is called the spring index.

38. What is solid length?

The length of a spring under the maximum compression is called its solid length. It is the product of total number of coils and the diameter of wire.

$Ls = n_t \times d$

Where, n_t = total number of coils.

39. Define spring rate (stiffness).

The spring stiffness or spring constant is defined as the load required per unit deflection of the spring.

$K = W/y$

Where W -load
Y – deflection

40. Define pitch.

Pitch of the spring is defined as the axial distance between the adjacent coils in uncompressed state. Mathematically

$$\text{Pitch} = \frac{\text{free length}}{n-1}$$

41. Define helical springs.

The helical springs are made up of a wire coiled in the form of a helix and is primarily intended for compressive or tensile load

42. What are the differences between closed coil & open coil helical springs?

The spring wires are coiled very closely, each turn is nearly at right angles to the axis of helix	The wires are coiled such that there is a gap between the two consecutive turns.
Helix angle is less than 10^o	Helix angle is large ($>10^o$)

FLUID MECHANICS
UNIT - III

1. Define density or mass density.
   Density of a fluid is defined as the ratio of the mass of a fluid to its volume. Its unit is Kg/m^3.

2. Define specific gravity or relative density.
   Specific gravity is defined as the ratio of the weight density of a fluid to the weight density of a standard of a standard fluid.. for liqids, the standard fluid is taken as water and for gases , the standard fluid is taken as air.

3. Define specific volume.
   Specific volume of a fluid is defined as the volume of a fluid occupied by a unit mass or volume per unit mass of a fluid. It is expressed as m^3/Kg.

4. Define specific weight or weight density.
   Specific weight or weight density of a fluid is defined as the ratio between the weight of a fluid to its volume. It is denoted by ω.
   $\omega = \rho g$

5. Define compressibility.
   Compressibilty is the reciprocal of bulk modulus of elasticity K, which is defined as the ratio of compressine to volumetric strain.

6. Define coefficient of compressibility.
   Coefficient of compressibility is denoted by β and defined as volumetric strain per unit compressive stress.

7. Define surface tension of fluids.
   The surface tension of a fluid is the property which enables the fluid to resist tensile stress. It is due to the cohesion between the molecules at the surface of a liquid.

8. What is meant by capillarity.
   Capillarity is defined as the phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent level of liquid, when the tube is dipped vertically in the liquid. Its unit is metre.

9. What is meant by capillary rise and capillary depression.
   The rise of liquid surface in the capillary tube is known as capillary rise and the fall of liquid surface in the capillary tube is known as capillary depression.

10. What is known as viscosity.
    The property of a fluid whidh offers resistance to the movement of one layer of fluid over adjacent layers of fluids is called viscosity.

11. What is meant by kinematic viscosity?

The ratio between the dynamic viscosity and density is defined as kinematic viscosity of a fluid.

12. State 'Newton's law of viscosity.

It states that 'For a steady uniform flow, the shear stress on a fluid element is layer is directly proportional to the rate of shear strain. The constant of proportionality is called the coefficient of viscosity.

13. State Pascal's law.

Pascal's law states that the pressure or intensity of pressure at a point in a static fluid is equal in all directions.

14. Define Newtonian and Non-Nwtonian fluids.

A real fluid in which the shear stress is proportional to the rate of shear strain is known as Newtonian fluid.

Fluids which donot obey Newton's law of viscosity are called Non-Newtonian fluids.

15. State Bernoulli's equation.

In a steady flow of frictionless and incompressible fluid flow system, the total energy per unit weight of flowing fluid remains constant.

16. What is known as Euler's equation of motion.

If the flow is assumed to be ideal viscous force and it is zero then the equation of motion is known as Euler's equation of motion.

17. Mention hydraulic devices using Bernoulli's equation.

1. Venturimeter
2. Orificemeter
3. Pitot tube

18. What is a flow net?

The graphical pattern obtained by the intersection of stream lines and equipotential lines are known as flow net.

19. Define Stream line.

Stream line is said to be an imaginary line drawn through a flow field such that the tangent at each point on the line indicates the direction of the velocity of the fluid particle at that point.

20. What are manometers?

Manometars are defined as the devices used for measuring the pressure at a point in afluid by balancing the column of fluid by the same or another column of the fluid.

UNIT - IV

1. What is known as Navier Stoke's equation.
   For flow, where force due to turbulence is negligible, the resulting equation of motion is known as N avier-Stoke's equation.

2. Define Reynold's number.
   It is defined as the ratio of the inertia force of a flowing fluid and the viscous force of the fluid.

3. What is an incompressible fluid flow.
   When th changes in volume and density of fluid are insignificant, the flow is said to be incompressible flow.

4. What are the types of fluid flow?
   Laminar flow and Turbulent flow.

5. State the difference between Euler's equation and Navier-Stoke's equation.
   In Euler's equation, the fluid is assumed as ideal, only gravity and pressure forces are considered whereas in Navier-Stoke's equation, the gravity, pressure and viscous forces are taken into consideration.

6. What does Haigen-Poiseulle equation refer to?
   The equation refers to yhe value of loss of head in a pipe of length 'L' due to viscosity in alaminar flow.

7. Give the range of Reynold's number for laminar and turbulent flow in a pipe.
   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.

8. What is a pipe?
   A pipe is a closed conduit and it is used for carrying water or any other fluids under pressure.

9. 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
   1. Major losses
   2. Minor losses

10. 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.

11. Explain minor losses in a pipe.

The minor losses are due to sudden expansion of the pipe, sudden enlargement of the pipe, bend in a pipe, pipe fittings and obstruction in the pipe.

12. State Darcy-Weisbach equation.

$$h_f = \frac{4flv_2}{2gd}$$

where, h_f = Head loss due to friction in metre
L = Length of the pipe in m
d = Diameter of the pipe in m
V = Velocity of flow in m/sec
f = Coefficient of friction

13. State Chezy's formula.

The heads loss due to friction in a pipe can be calculated by Chezy's formula which is given by

$$V = C\sqrt{mi}$$

where V = mean velocity of flow
C = Chezy's constant
m = hydraulic mean depth (m = wetted area/wetted perimeter)

$$i = \frac{h_f}{L}$$

14. What is meant by hydraulic gradient line?

The line representing the sum of pressure head, datum head with respect to some reference line is called hydraulic gradient line.

15. What is ment by total energy line?

The line representing the sum of pressure head, datum head and velocity head with respect to some reference line is known as total energy line.

16. What is compound pipe?

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

17. Explain the term pipes in parallel.

Sometimes a new pipe has to be laid along with existing one, in order to increase the discharge from one tank into another, such an arrangement is known as pipes in parallel.

18. What is meant by Moody's chart and what are the uses of Moody's chart?

Moody's chart is the chart showing the variation of friction factor "f" for the full range of Reynold's numbers.

Moody's diagram is accurate to about 15% for design calculations and used for a large number of applications. It can be used for non-circular conduits and also for open channels.

19. What is meant by drag?

Drag is defined as the component of the force exerted by a flowing fluid on a solid stationary body in the direction of flow.

20. Define lift.

Lift force is defined as the force exerted by a flowing fluid on a solid body in the direction of flow.

21. What are the causes for drag and lift?

The drag and lift experienced by an object placed in a fluid stream are due to motion of fluid and weight of the body.

22. Define the term friction drag.

Friction drag or shear drag or skin drag occurs on a body due to tangential shear caused by the velocity gradient at the surface of the body.

23. State Buckingham's π – theorem.

If there are n variables (independent and dependent variables) in a physical phenomenon and if these variables contain m fundamental dimensions (M, L, T), then the variables are arranged into (n-m) dimensionless terms. Each term is called π– term.

UNIT - V

1. What are fluid machines?

The machines which use the liquid or gas for the transfer of energy from fluid to rotor or from rotor to fluid, are known as fluid machines.

2. What are hydraulic machines and thermal turbo machines?

If liquid is used for the transfer of energy, then machines are known as hydraulic machines whereas if gas is used then machnes are known as thermal turbo machines.

3. How are fluid machines classified?

Fluid machines are classified into 2 categories depending upon the direction of transfer of energy :

1. Turbines
2. Pumps or compressors

4. What are called turbines?

The turbomachines in which energy is transferred from working fluid to rotor are called turbines. If the working fluif is liquid, then these machines are known as hydr-turbines or hydraulic turbines whereas if the working fluid is gas or steam then these turbines are called a sgas turbines or steam turbines.

5. What are called pumps?

The turbomachines in which energy is transferred from rotor to working fluid are called pumps and compressor if the working fluid is gas, air etc.

6. What is known as Euler's equation for turbo-machines?

The general expression for the work done per second on the wheel is

$$\rho a V_1 [V_{w1} u_1 \pm V_{w2} u_2]$$

7. Define Gross Head of a turbine.

The difference between the head race level and tail race lavel when no water is flowing is known as Gross Head

8. Define Net head of a turbine.

It is also called effective head and is defined as the head available at the inlet of the turbine.

$$H = H_g - h_f$$

9. What are the efficiencies of a turbine?

1. Hydraulic efficiency 2. Mechanical efficiency
3. Volumetric efficiency 4.Overall efficiency

10. Define Hydraulic efficiency.

It is defined as the ratio of the power given by water to the runner of a turbine to the power supplied by the water at the inlet of the turbine.

11. Define Mechanical efficiency.

The power delivered by water to the runner of a turbine is transmitted to the shaft of the turbine. Due to mechanical losses, the power available at the shaft of the turbine is less than the power delivered to the runner of a turbine. The ratio of the power available at the shaft of the turbine to the power delivered to the runner is defined as mechanical efficiency.

12. Define Volumetric efficiency.

The ratio of the volume of the water actually striking the runner to the volume of water supplied to the turbine is defined as Volumetric efficiency.

13. Define Overall efficicency.

It is defined as the ratio of the power available at the shaft of the turbine to the power supplied by the water at the inlet of the turbine.

Overall efficiency = Mechanical efficiency x Hydraulic efficiency

14. What is an impulse turbine and a reaction turbine?

If at the inlet of the turbine, the energy available is only kinetic energy, the turbine is known as impulse turbine.

If at the inlet of the turbine, the water possesses kinetic energy as well as pressure energy, the turbine is known as reaction turbine.

15. Define Jet Ratio.

It is defined as the ratio of the pitch diameter (D) of the Pelton wheel to the diameter of the jet (d). it is denoted by 'm' and is given as

$$m = D/d$$

16. Define Specific speed of a centrifugal pump.

The specific speed of a centrifugal pump is defined as the speed of a geometrically similar pump which would deliver one cubic metre of liquid per second against a head of one metre.

17. Define Priming of a centrifugal pump.

Priming of a centrifugal pump is defined as the operation in which the suction pipe, casing of the pump and a portion of the delivery pipe upto the delivery valve is completely filled up from outside source with the liquid to be raised by the pump before starting the pump.

18. Define cavitation.

Cavitation is defined as the phenomenon of formation of vapour bubbles of a flowing liquid in a region where the pressure of the fluid falls below its vapour pressure and the sudden collapsing of these vapour bubbles in a region of higher pressure.

19. What is a reciprocating pump?

Reciprocating pump is a positive displacement pump. This means the liquid is first sucked into the cylinder and then displaced or pushed by the thrust of a piston.

20. What are air vessels?

An air vessel is a closed chamber containing compressed air in the top portion and liquid at the bottom of the chamber. At the base of the chamber there is an opening through which the liquid may flow into the vessel or out from the vessel. When the liquid enters the air vessel, the air gets compressed further and when the liquid flows out of the vessel, the air will expand into the chamber.

21. What are pump characteristics?

Pump characteristic means the characteristic curves of a pump. Characteristic curves of centrifugal pumps are defined as those curves which are plotted from the results of a number of tests on the centrifugal pump. These curves are necessary to predict the behaviour and performance of the pump when the pump is working under different flow rate, head and speed.

22. What is the purpose of an air vessel fitted in the pump?

1.To obtain a continuous supply of liquid at a uniform rate.
2.To save a considerable amount of work in overcoming the frictional resistance in the suction and delivery pipes, and
3.To run the pump at a high speed with out separation.

23. What is the work saved by fitting a air vessel in a single acting ,double acting pump?

Work saved by fitting air vessels in a single acting pump is 84.87%,
In a double acting pump the work saved is 39.2%.

24. Define coefficient of discharge of reciprocating pump?

It is defined as the ratio of actual discharge to theoretical discharge of reciprocating pump.

$cd=Q_{act}/Q_{th}$

25. Define centrifugal pump?

It is defined as a device, which converts mechanical energy in the hydraulic energy by means of centrifugal force acting in the cylinder.

26. What is Discharge through a Reciprocating Pump in Per sec ?

For Single acting

Discharge (Q)=ALN/60

Where

A=Area of the Cylinder in m^2
L=Length of Stroke in m.
N=Speed of Crank in RPM

For Double acting

Q=2ALN/60

27. What is the Workdone by Reciprocating Pump Per sec.?

Workdone = $\rho gALN(h_s+h_d)/60$ (for single acting)

For Double acting:

Work done= $2\rho gALN(h_s+h_d)/60$

Where

ρ=Density of Water in kg/m^3
A=Area of the Cylinder in m^2
L=Length of Stroke in m
N=Speed in rpm
h_s,h_d=Suction and Delivery head in m

28. What is the Pressure head due to acceleration in the Suction & Delivery Pipe ?

$$h_f = 4fl(A/a * \omega r \sin\theta)^2/2gd$$

where

f=Co-efficient of friction. A = Area of piston in m^2. a = Area of pipe in m^2.

ω = Angular speed r = Radius of crank

29. What is the relation between Work done of a Pump and Area of Indicator Diagram ?

Work done by the pump is Proportional to the area of the Indicator diagram.

30. What is the Work done by the Pump per sec due to acceleration and friction in the suction and delivery Pipes ?

For single acting

$$W = \rho gALN(hs+hd+0.67hfs+0.67hfd)/60$$

For Double acting

$$W = 2\rho gALN(hs+hd+0.67hfs+0.67hfd)/60$$

Where

hfs, hfd =loss of head due to acceleration in the suction and delivery Pipe.

31. What is the Mean Velocity of Single acting reciprocating pump ?

$$v = A\omega r/3.14a$$

Where

ω =Angular velocity in rad/sec

r =Radius of the crank in m

A and a =Area of cylinder and Pipe in m^2