STUDY MATERIAL

SUBJECT : BASIC MECHANICAL ENGG.(BME)

MODULE-IV

SEMESTER :1ST /2ND

(ALL BRANCHES)

CONTENTS :

- OBJECTIVE TYPE QUESTIONS AND ANSWERS
- SHORT TYPE QUESTIONS AND ANSWERS
- LONG TYPE QUESTIONS AND ANSWERS

DEPARTMENT OF MECHANICAL ENGINEERING

Imp. Points

- Modulus of resilience is the work done on a unit volume of material as the force is gradually increased from zero to elastic limit.
- Modulus of toughness is the work done on a unit volume of material as the force is gradually increased from zero to rupture point.
- Working stress is defined as the actual stress of a material under a given loading. The maximum safe stress that a material can carry is termed as the allowable stress.
- The allowable stress should be limited to values not exceeding the proportional limit.
- The ratio of this strength (ultimate or yield strength) to allowable strength is called the factor of safety.
- If the temperature of a material is increased, there will be expansion in the material (except ice) and if the temperature is decreased, there will be contraction in the material. If these expansion and contraction occur freely there will be no stress in the material and if these expansion or contraction is prevented then stress will be setup in the material which is known as temperature of thermal stress.

MULTIPLE CHOICE QUESTIONS

1. Hooke's law holds good up to
   (a) yield point (b) proportional limit
   (c) plastic limit (d) ultimate point
2. Strain is the ratio of
   (a) change in volume to original volume
   (b) change in length to original length
   (c) change in cross-section area to original cross-section area
   (d) all of the above
3. Deformation per unit length is known as
   (a) linear strain (b) lateral strain
   (c) volumetric strain (d) none of these
4. Modulus of rigidity is defined as the ratio of
   (a) longitudinal stress and longitudinal strain
   (b) lateral stress and lateral strain
   (c) shear stress and shear strain
   (d) any one of the above
5. Tensile strength of a material is obtained by dividing the maximum load during the test by the
   (a) area at the time of fracture
   (b) original cross-section area
   (c) average of (a) and (b)
   (d) minimum area after fracture
6. For steel, the strength in shear in comparison to tension is nearly
   (a) same (b) half
   (c) one-third (d) two-third
7. In tensile test of steel, the breaking stress as compared to ultimate stress is
   (a) less (b) more
   (c) same (d) none of these
8. The value of modulus of elasticity for mild steel is of the order of
   (a) 2.1×10^5 kg/cm^2
   (b) 2.1×10^6 kg/cm^2
   (c) 2.1×10^7 kg/cm^2
   (d) 2.1×10^8 kg/cm^2
9. The value of Poisson ratio for steel lies between
   (a) 0.01 and 0.1 (b) 0.23 and 0.27
   (c) 0.25 and 0.33 (d) 0.4 and 0.6
10. The property by which a material returns to its original shape after removal of external load is known as
    (a) elasticity (b) plasticity
    (c) ductility (d) malleability
11. The materials which exhibit the same elastic properties in all directions are known as
    (a) homogeneous (b) isotropic
    (c) isentropic (d) inelastic
12. The properties of a material which allows it to be drawn into a smaller section is called
    (a) elasticity (b) plasticity
    (c) ductility (d) malleability
13. Poisson ratio is defined as
    (a) longitudinal stress/longitudinal strain
    (b) longitudinal stress/lateral stress
    (c) lateral strain/longitudinal strain
    (d) lateral stress/lateral strain
14. The property of material by which it can be rolled into a sheet is known as
    (a) elasticity (b) plasticity
    (c) ductility (d) malleability
15. In tensile test of mild steel, necking starts from
    (a) proportional limit
    (b) plastic limit
    (c) ultimate point
    (d) rupture point

16. The strain energy stored in a body, when it is strained up to elastic limit is known as
    (a) resilience
    (b) proof resilience
    (c) modulus of resilience
    (d) toughness
17. The maximum strain energy stored in a body is known as
    (a) resilience
    (b) proof resilience
    (c) modulus of resilience
    (d) toughness
18. Proof resilience per unit volume is known as
    (a) resilience
    (b) proof resilience
    (c) modulus of resilience
    (d) toughness
19. The deformation of a bar under its own weight compared to the deformation of the same body subjected to a direct load equal to weight of the body is
    (a) same (b) half
    (c) double (d) one fourth
20. The tensile stress in a conical rod, having diameter D at bottom, d at top, length l and subjected to tensile force F, at distance x from small end will be
    (a) $\frac{4F}{\pi D^2}$
    (b) $\frac{4F}{\pi d^2}$
    (c) $\frac{4Fl^2}{\pi\left((D-d)x+ld\right)^2}$
    (d) $\frac{4F}{\pi(D-d)^2}$

Answers

1. (b), 2. (d), 3. (a), 4. (c), 5. (b), 6. (b), 7. (a), 8. (b), 9. (c), 10. (d), 11. (b), 12. (c), 13. (c), 14. (d), 15. (c), 16. (a), 17. (b), 18. (b), 19. (b), 20. (c)

REVIEW QUESTIONS (Practice following Questions)

1. Define stress and strain.
2. What do you mean by normal stress and shear stress?
3. Define longitudinal and lateral strains.
4. Define linear, superficial, and volumetric strain.
5. Define: Young's modulus, elastic limit, proportional limit, yield point, ultimate point, breaking point, modulus of rigidity, bulk modulus, and Poisson's ratio.
6. Differentiate engineering strain and true strain.
7. State Hooke's law.
8. Establish relationship between E and K.
9. Establish relationship between E and G.
10. Establish relationship between E, K, and G.
11. Differentiate compound bar and composite bar.
12. Write note on gradual loading, suddenly applied loading, and impact loading.

Imp. Points

- Hypoid gears resemble spiral bevels, but the axes of the pinion shaft and gear shaft do not intersect.
- If a tooth of a helical gear makes complete revolutions on the pitch cylinder, the resulting gear is known as worm. The mating gear is called worm wheel.
- In a simple gear train, all the gears are mounted on their separate shafts and the gear axes remain fixed in a frame. All the paired gears are moved in opposite directions.
- When two or more gears rotate about same axis and have same angular velocity, it is known as compound gear train.
- If axes of the first and the last wheels of a compound gears coincide, it is called reverted gear train.
- If the axis of at least one gear in gear train moves relative to fixed axis or frame, such type of gear train is known as epicyclic gear train.
- When an annular gear A is used in epicyclic gear train, it is known as sun and planet gear train.

MULTIPLE CHOICE QUESTIONS

1. In a belt drive pulley acts as
   (a) sliding pair (b) rolling pair
   (c) turning pair (d) none of these
2. When two pulleys are connected by a cross-belt drive, then both the pulleys rotate in
   (a) same direction (b) opposite direction
   (c) not necessary (d) none of these
3. Length of open belt connecting two pulleys of radii r_1 and r_2 and at a centre distance D apart, is
   (a) $\pi (r_1 + r_2) + (r_1 - r_2)^2/D + 2D$
   (b) $\pi (r_1 + r_2) + (r_1 + r_2)^2/D + 2D$
   (c) $\pi (r_1 - r_2) + (r_1 + r_2)^2/D + 2D$
   (d) $\pi (r_1 + r_2) + (r_1 - r_2)^2/D + 2D$
4. Length of cross belt connecting two pulleys of radii r_1 and r_2 and at a centre distance D apart, is
   (a) $\pi (r_1 + r_2) + (r_1 - r_2)^2/D + 2D$
   (b) $\pi (r_1 + r_2) + (r_1 + r_2)^2/D + 2D$
   (c) $\pi (r_1 - r_2) + (r_1 + r_2)^2/D + 2D$
   (d) $\pi (r_1 + r_2) + (r_1 - r_2)^2/D + 2D$
5. Angle of contact in cross-belt drive in comparison to open-belt drive is
   (a) more (b) less
   (c) same (d) none
6. Slip in belt drive is difference between
   (a) angular velocities between two pulleys
   (b) linear speed of the rim of pulleys and the belt on it
   (c) the velocities of two pulleys
   (d) none of these
7. In belt drives, effect of centrifugal tension is
   (a) to increase the driving power
   (b) to decrease the driving power
   (c) nor appreciable on driving power
   (d) none of these
8. If T_1 and T_2 are tensions on tight and slack side of belt, θ is angle of contact and μ is coefficient of friction between belt and pulley, then ratio of tension is
   (a) $T_1/T_2 = \mu\theta$ (b) $T_1/T_2 = e^{\mu\theta}$
   (c) $T_1/T_2 = e\mu\theta$ (d) $T_1/T_2 = e^{1/\mu\theta}$
9. For maximum power transmission, the maximum tension T_{max} in the belt is equal to
   (a) T_c (b) $2T_c$
   (c) $3T_c$ (d) $T_c/3$
10. Creep in belt is due to
    (a) elasticity of belt material
    (b) elongation of belt due to tension
    (c) differential elongation of belt due to difference in tension on two sides of a pulley
    (d) plasticity of belt material
11. Included angle of V-belt is generally
    (a) 10° to 20° (b) 20° to 30°
    (c) 30° to 40° (d) 50° to 60°
12. In designation 6 by 19 rope, 6 and 19, respectively, stand for
    (a) diameter of wire rope and number of strands
    (b) diameter of wire rope and number of wires
    (c) number of wires and number of strands
    (d) number of strands and number of wires
13. A chain drive is used for
    (a) short distance
    (b) medium distance
    (c) long distance
    (d) distance is no barrier
14. Silent chain is made of
    (a) links and blocks
    (b) links, pins, bushings, and rollers

(c) three or more roller chains
(d) inverted tooth and overlapping links

15. Wire ropes are used for
(a) low speeds and low tension
(b) low speeds and high tension
(c) high speeds and low tension
(d) none of these

16. The ratio of the number of teeth and pitch circle diameter is called
(a) pitch (b) circular pitch
(c) diametral pitch (d) module

17. The circle passing through the bottom of the teeth of gear is known as
(a) inner circle (b) base circle
(c) addendum circle (d) dedendum circle

18. The circle passing through the top of the teeth of gear is known as
(a) inner circle (b) base circle
(c) addendum circle (d) dedendum circle

19. Pitch circle diameter of an involute gear is
(a) independent of any other factor
(b) dependent on pressure angle
(c) constant for set of meshing gears
(d) proportional to base diameter

20. The surface of the gear below the pitch circle is called
(a) face (b) flank
(c) bottom tooth (d) tooth depth

21. Law of the gearing is satisfied if
(a) two surfaces slide smoothly
(b) common normal at the point of contact passes through pitch point on the line joining the centres of rotation
(c) addendum is greater than dedendum
(d) none of these

Answers

1. (b), 2. (b), 3. (a), 4. (b), 5. (a), 6. (b), 7. (c), 8. (b), 9. (c), 10. (c), 11. (c), 12. (d), 13. (a), 14. (d), 15. (b). 16. (c), 17. (d), 18. (c), 19. (b), 20. (b), 21. (b)

FILL IN THE BLANKS

1. The gear train in which the first and last gear are on the same axis is known as _____.
2. The difference between dedendum and addendum is known as _____.
3. Best profile to obtain resistance against wear is _____.
4. The product of circular pitch and dimetral pitch is equal to _____.

Answers

1. Reverted gear train, 2. Clearance, 3. 14½° full depth involute, 4. Π.

REVIEW QUESTIONS (Practice following Questions)

1. In a flat bet drive prove that $\frac{T_1}{T_2} = e^{\mu\theta}$;

where T_1 is tension in tight side, T_2 is tension in slack side, μ is coefficient of friction, θ is angle of lapin radian.

2. What is initial tension in belt? Explain the effect of centrifugal tension in belt drive.
3. Find the condition for maximum power transmission in belt drive.
4. Find the expression for the length of belt in open-belt drive.

MULTIPLE CHOICE QUESTIONS [Clutch, Brake & Coupling]

1. The friction moment in clutches with assumption of uniform wear as compared to uniform pressure is
   (a) more (b) less
   (c) same (d) none of these
2. If ϕ be the angle of friction, then radius of friction circle is given by
   (a) r (b) $r \sin \phi$
   (c) $r \cos \phi$ (d) None of these
3. Friction radius in comparison to worn-out will be
   (a) same (b) more
   (c) less (d) none of these
4. For new clutches and brakes, friction radius is equal to
   (a) $\frac{D+d}{4}$ (b) $\frac{1}{3}\frac{D^3-d^3}{D^2-d^2}$
   (c) $\frac{1}{2}\frac{D^3-d^3}{D^2-d^2}$ (d) $\frac{1}{3}\frac{D^2-d^2}{D^3-d^3}$
5. For uniform wear condition of brakes and clutches, friction radius is equal to
   (a) $\frac{D+d}{4}$ (b) $\frac{1}{3}\frac{D^3-d^3}{D^2-d^2}$
   (c) $\frac{1}{2}\frac{D^3-d^3}{D^2-d^2}$ (d) $\frac{1}{3}\frac{D^2-d^2}{D^3-d^3}$
6. The commonly used angle between the cone surface and horizontal axis for a cone clutch utilizing leather to asbestos lining is about
   (a) 8° (b) 12.5°
   (c) 20° (d) 30°
7. In a cone clutch, a given torque can be transmitted by a relatively small axial force if the cone-face angle is
   (a) more (b) less
   (c) same (d) any angle
8. For a block brake, the equivalent coefficient of friction is equal to
   (a) $\frac{4\sin\theta}{2\theta+\sin 2\theta}\mu$ (b) $\frac{2\sin\theta}{2\theta+\sin 2\theta}\mu$
   (c) $\frac{4\sin 2\theta}{2\theta+\sin 2\theta}\mu$ (d) $\frac{2\sin 2\theta}{2\theta+\sin 2\theta}\mu$
9. The percentage of total brake effort that results from self-energizing action depends on
   (a) the location of brake arm pivot point
   (b) the coefficient of friction
   (c) the direction of rotation of the brake drum
   (d) all of the above
10. In order to prevent the brake arm from grabbing, the moment of friction force about the brake arm pivot point should be
    (a) less than total required braking effort
    (b) greater than total required braking effort
    (c) equal to total required braking effort
    (d) none of these
11. Coupling, which prevents transmission of shock from one shaft to another, is known as
    (a) oldham coupling
    (b) universal coupling
    (c) flexible coupling
    (d) jaw coupling
12. In flange coupling, the weakest element is
    (a) flange (b) bolt
    (c) key (d) shaft
13. A flange coupling is a
    (a) rigid coupling (b) flexible coupling
    (c) both (a) and (b) (d) none of these
14. In flange coupling, the flanges are joined together by
    (a) headless taper bolts
    (b) rivets
    (c) nuts and bolts
    (d) studs
15. Number of bolts in flange coupling should not be less than
    (a) 2 (b) 3
    (c) 4 (d) 8
16. A universal coupling is
    (a) rigid coupling (b) flexible coupling
    (c) both (a)and (b) (d) none of these
17. A universal coupling is used to connect the shaft
    (a) whose axes intersect at small angle
    (b) which are perfectly aligned
    (c) which are not aligned
    (d) have lateral misalignment

Answers

1. (b), 2. (b), 3. (b), 4. (b), 5. (a), 6. (b), 7. (b), 8. (a), 9. (d), 10. (a). 11. (c), 12. (c), 13. (a), 14. (c), 15. (b) 16. (b), 17 (a).

REVIEW QUESTIONS (Practice these following Questions)

1. Explain the advantages and disadvantages of flexible and rigid couplings.
2. Explain the role of clutch in power transmission.
3. Derive the formula for torque transmitted by a single plate disc clutch assuming uniform pressure.
4. Derive the formula for torque transmitted by a cone clutch assuming uniform wear.
5. Which of the two assumptions: uniform pressure and uniform wear would you like to use in designing friction clutch. Explain the reasons.
6. Describe the working of centrifugal clutch and express the equation for torque transmitted.
7. What is use of braking system in a vehicle? Classify the various types of brakes.
8. Describe the working of internal shoe expanding brake with a neat sketch. Also, derive the expression for braking torque.
9. Prove in band–block brake.

$$\frac{T_0}{T_n} = \left(\frac{1+\mu\tan\theta}{1-\mu\tan\theta}\right)^n$$

10. Differentiate the functions of coupling, clutch, and brake.

PROBLEMS FOR PRACTICE (Imp. Numericals for Semester Exam.)

1. A single plate clutch of both sides effective has outer and inner radii as 300 and 200 mm. The maximum intensity of pressure at any point in the contact surface should not exceed to 0.1 N/m². If the coefficient of friction is 0.3, find the power transmitted by the clutch at the speed of 2,500 rpm. Assuming

   (i) Uniform wear.

   (ii) Uniform pressure.
2. A multi-disc clutch has three discs on the driving shaft and two discs on driven shaft. Outside radius of the contact surface is 180 mm and inside radius is 120 mm. Assuming uniform wear and coefficient of friction is 0.3. Find the maximum axial intensity of pressure between the discs for transmitting 25 kW at 1,500 rpm.
3. A cone clutch has cone angle of 40°. Maximum pressure between contact surface is limited to 0.3 N/m² and width of conical surface is half of the mean radius, find the radii of the conical surface to transmit 30 kW at 2,000 rpm. Assume uniform wear and coefficient of friction as 0.3.
4. There are four shoes in centrifugal clutch. The mass of each shoe is 5 kg. When the clutch is at rest, the force exerted by spring on shoes is 200 N. The clearance between shoes and drum is 4 mm. Spring constant is 25 N/mm. The distance of centre of mass of shoes from the axis is 100 mm. The internal diameter of the drum is 225 mm. Coefficient of friction of the brake lining is 0.3. Find the power transmitted by the clutch at 500 rpm.
5. A single block brake, as shown in Figure 16.8 (a), has brake drum diameter of 250 mm. It can withstand 300 N m torque at 500 rpm. The coefficient of friction between block and drum is 0.25. Determine the force (P) required to apply when the drum rotates in

MODULE - 4

Fasteners and Power Transmission Devices & Mechanical Measurements

4.1 Differentiate screw, bolt, stud and nut in their structures.

Basically all threaded fasteners are made by cutting helical grooves on the cylindrical areas. In screw (or) bolt, a single helical groove is made from one end to the other end, but the screw is tapered from one end to other end where as the bolt is having constant diameter throughout its length. In stud, helical grooves are made in two different directions, leaving the centre portion unscrewed. In a nut, helical grooves are made in the innerside of a sleeve.

Screws and Bolts are having heads, but studs are not having heads.

4.2 By what materials threaded fasteners are made?

Steel is the material of which most of the fasteners are made. For improving their properties alloy steels like nickel-steel, nickel-chromium steel, chromium-vanadium steel are preferred. For special purpose, threaded fasteners are made of aluminium, brass, copper nickel and plastics etc.

4.3 Define the following terms.

(a) Major diameter, (or) nominal diameter

(b) Minor diameter (or) root diameter

(c) Pitch

(d) Lead

(a) Major diameter or nominal diameter: It is the diameter of a co-axial cylinder that would just touch the crest of the external thread as in the case of bolt or root of an internal thread as in the case of nut. It is the maximum diameter, also called as outside diameter of thread.

(b) Minor diameter or root diameter: It is the diameter of a co-axial cylinder that would just touch the root of an external thread (ie., bolt) and crest of as internal thread (nut). This is the minimum diameter of screw. It is also called as core diameter.

(c) Pitch: It is defined as the distance, measured parallel to the axis, between corresponding points of adjacent threads in the same axial plane.

(d) Lead: It is distance in the axial direction moved by a screw during one revolution of the screw. It is nothing but the distance between two

corresponding points in the same helix. In the multi-start thread, lead is equal to the product of pitch and the number of starts ie., Lead $= n \times$ pitch where n is the number of starts.

4.4 How is a screw thread designated?

In India, metric threads are adopted as standard threads. There are two types of metric threads namely coarse and fine threads. Coarse thread is designated by the capital letter M followed by the major diameter of the thread in mm. For example M10. The pitch is additionally indicated for fine thread. For example $M10 \times 1.25$.

4.5 What is lap riveted joint?

In this type of joint, two plates are kept one over the other at their ends (i.e, overlapping) and riveted. Here the covering plates are not required as required for butt joints.

4.6 What is Butt-riveted joint?

In this joint, the main plates are kept in alignment touching each other by their ends and a coverplate is placed on one side or on both sides of the main plates and then they are riveted.

4.7 Name the types of transmission belts.

Based on the belt cross-section, the types of transmission belts are

1. Flat belt, 2. V-belt, 3. Round belt.

4.8 What are the commonly used belt materials?

1. Leather, 2. Cotton or Canvas, 3. Rubber, 4. Nylon core, 5. Balata, 6. Fabric.

4.9 What are the different types of flat belt drives?

Different types of Flat belt drives are

1. Open belt drive, 2. Crossed belt drive, 3. Quarter-turn belt drive, 4. Compound belt drive, 5. Belt drive with idler pulley 6. Stepped or Cone pulley, 7. Fast and loose pulley drive

4.10 What is slip in a flat belt drive?

In a flat belt drive, when the frictional grip between the pulley and belt is insufficient, the driver will have some forward motion without belt, which is known as **slip**.

4.11 What are the advantages of wire rope drives?

(a) High strength to weight ratio

(b) Silent operation at high speeds
(c) Greater reliability
(d) High efficiency
(e) Low cost
(f) Ability to withstand shock loads.

4.12 Name the applications of wire rope drive.

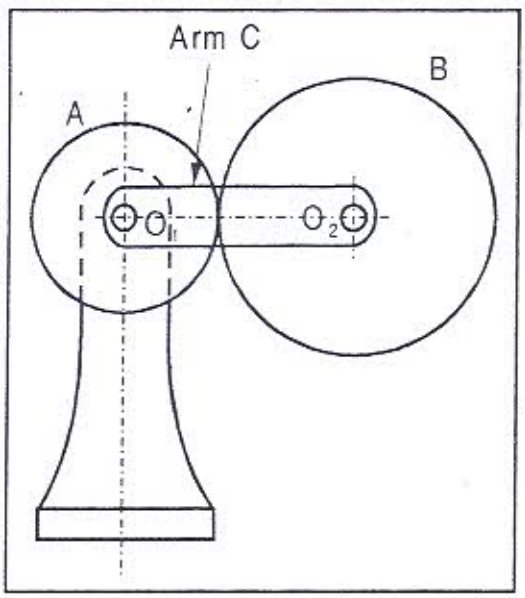
Wire rope drive is best suited for the applications, where large amount of power is to be transmitted over a long distance. Wire ropes are used in elevators, mine hoists, cranes, conveyors, hauling devices, suspension bridges, etc.

4.13 List out the applications of epicyclic gear train.

Epicyclic gear trains are used in the
(i) Back gear of lathe
(ii) Differential gears of automobiles
(iii) Hoists
(iv) Pulley blocks
(v) Wrist watches etc.

4.14 What is epicylic gear train? Give a practical example.

A simple epicyclic gear train is shown in Fig., where a gear A and the arm C have a common axis at O_1 about which they can rotate. The gear B meshes with gear A and has its axis on the arm at O_2, about which the gear B can rotate. If the arm is fixed, the gear train is simple and gear A can drive gear B or ***vice-versa***, but if gear A is fixed and the arm is rotated about the axis of gear A (*i.e.* O_1), then the gear B is forced to rotate ***upon*** and ***around*** gear A. Such a motion is called **epicyclic** and the gear trains arranged in such a manner that one or more of their members move upon and around another member are known as ***epicyclic gear trains***.



The epicyclic gear trains are useful for transmitting high velocity

ratios with gears of moderate size in a comparatively lesser space.

4.15 Name the various gear trains?

The various gear trains are

1. Simple gear train
2. Compound gear train
3. Reverted gear train
4. Epicyclic gear train.

4.16 What is addendum and dedendum?

Addendum: It is the radial distance of a tooth from the pitch circle to the top of the tooth

Dedendum: It is the radial distance of a tooth from the pitch circle to the bottom of the tooth.

4.17 What is gear train?

Two or more gears are made to mesh with each other to transmit power from one shaft to another. Such a combination is called gear train

4.18 What are the four commonly used types of brakes?

The four commonly used types of brakes are:

1. Hydraulic brakes
2. Electric brakes
3. Mechanical brakes → Radial brakes
   Mechanical brakes → Axial brakes

4.19 What is a brake?

A brake is a device by means of which artificial resistance is applied to a moving machine member in order to retard (or) stop the motion of the machine. The kinetic energy absorbed by brakes is dissipated in the form of heat.

4.20 What is reverted gear train?

When the axis of the first gear (i.e.) first driver and the last gear (i.e.) last driver are co-axial, then the gear train is known as reverted gear train.

4.21 What is a coupling?

Coupling is a machine member, employed to connect two power transmitting shafts through keys.

4.22 How couplings are classified?

Coupling are classified as follows:

(a) **Rigid couplings**

(i) Muff or sleeve couplings

(ii) Flange couplings

(iii) Flange couplings

(b) **Flexible Couplings**

(i) Universal couplings

(ii) Oldams couplings

(iii) Bushed pin couplings

4.23 Name the flexible coupling connected with propeller shaft of automobile vehicle.

Ans: Universal coupling

4.24 Why clutch is needed?

The purpose of the clutch is to allow the driver to couple or decouple the engine and transmission. In a scooter, the clutch is operated by hand where as in a car the clutch is operated by foot. It is necessary to stop the flow of power before gears are changed.

4.25 Define clutch?

A Clutch is a mechanism which connects or disconnects to the transmission power from one working part to the another, i.e. from the crankshaft and the gear box primary shaft smoothly.

The clutch enables the rotary motion of crankshaft to be transmitted to driven shaft whenever desired.

4.26 What are the different types of clutches commonly used in automobiles?

(a) Friction clutches

(i) Cone clutch

(ii) Single plate clutch

(iii) Multi-plate clutch

(b) Centrifugal and Magnetic Clutches

(c) Diaphragm clutch

(d) Hydraulic clutch

(e) Fluid flywheel

(f) Hydraulic torque converter

4.27 Mention few drawbacks of cone clutch

(i) If the angle of cone is made smaller than 20°, the cone tends to bind with the fly wheel (female cone) and it becomes difficult to disengage the clutch after it is removed.

(ii) A small amount of wear on the cone surfaces results in a considerable amount of axial movement of the male cone to engage which will not be possible.

4.28 What is the purpose of braking system?

Purpose of braking system

(a) To stop the vehicle at the desired position.

(b) To ensure the safety in driving.

(c) To keep vehicle under control.

4.29 How brakes are classified based on actuation?

(a) Mechanical brakes

(b) Hydraulic brakes

(c) Air brakes

(d) Servo brakes

(e) Electrical brakes

4.30 What are the advantages of hydraulic braking system?

1. Hydraulic fluid used in brake is incompressible which results in more efficient and consistent work or power output.
2. A leakage in a hydraulic system is easier to spot during maintenance operation.
3. Hydraulic fluid operates very well even in a very hot working environment, and it is able to sustain its viscosity, density and fluid temperature even if it is subjected under extreme heat.

4.31 What are the advantages of pneumatic braking system?

(i) The operating fluid (air) is easily available, unlike hydraulic braking system.

(ii) A minor leak do not results in failure of brake.

(iii) Trailers, which are powered by air brakes are easy to attach and detach their air line couplings.

4.32 What are the advantages of ABS?

ABS eliminates (or) greatly reduce the possibility of brake lock up and therefore provide a better control of the steering.

It helps to overcome the problems such as tyre lock up and uncontrolled spins.

4.33 What is force? How it is Measured?

Force is nothing but product of mass and acceleration.

$$\boxed{F = ma}$$

The force is a vector quantity. Unit of Force is Newton (N) Generally force can be measured by two methods

1. Direct force measurement
2. Indirect force measurement

4.34 What is indirect force Measurement?

In this measurement system, indirect comparison is made by an calibrated transducer that senses by means of a gravitational attraction or weight.

4.35 What is accelerometers?

The Accelerometer is a device, which is used to measure the acceleration. From that, we can find force in the following manner.

$$\boxed{F = ma}$$

Let, F – Force

m – Mass of the body

a – Acceleration

4.36 What is load cell?

A load cell is a transducer that is used to convert a force into electrical signal. This conversion is indirect and happens in 2 stages. Through a mechanical arrangement, the force being sensed is used to deform a strain gauge. The strain gauge converts deformation in to electrical signals.

4.37 What are the types of load cell?

The six main types of load cells are :

(i) Capacitive Load Cells

(ii) Magnetoelastic Load Cells

(iii) Strain Gauge Load Cells

(iv) Hydraulic Load Cells

(v) Pneumatic Load Cells

(vi) Shear Type Load Cells

4.38 What is fluid pressure sensor?

The fluid pressure sensors are used to measure the pressure within the fluid due to various forces acting on the fluid during flow. The fluid pressure sensors generate a signal as a function of the pressure applied by the gases or liquids.

4.39 What is Manometers?

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

4.40 What is mechanical gauge? What are the types?

Mechanical gauges are devices used for measuring the pressure by balancing the fluid column by the spring or dead weight. The commonly used mechanical pressure gauges are

(a) Diaphragm pressure gauge

(b) Bourdon tube pressure gauge

(c) Dead-weight pressure gauge

(d) Bellows pressure gauge

4.41 What are the methods used for Measuring Pressure?

Pressure can be measured by the following methods

1. Elastic pressure transducers: Bourdon tube pressure gauge (C-type, Helical type, Spiral type), Diaphragm pressure transducers, Bellows.
2. Manometer method.
3. Electric pressure transducers: Strain gauge type, potentiometer type (resistance type), capacitance type etc.,

4.42 What is tactile sensors?

The tactile (touching) sensors are devices which are used to measure the pressure distribution between a sensor and a target. These types of sensors are used in laptops, mobiles and ATM machines etc.

4.43 What is Single column manometer? What are the types?

Single column manometer is modified form of U tube Manometer having a very large reservoir. There are two types of single column manometer.

(a) Vertical single column Manometer

(b) Inclined single column Manometer.

4.44 Define Torque.

Torque is nothing but twisting moment. Torque may be defined as the force applied on the body on which it acts about an axis, causing the tendency of body to rotate.

The torque can be calculated by,

$$\text{Power, } P = \frac{2\pi NT}{60}$$

Let, T = Torque in (N-m); N = Speed in rpm

4.45 What is strain gauge?

The torque can also be measured by the help of a strain gauge. Strain gauge is a devices which identifies and senses the change in dimension (or) deformation.

4.46 What are the types of flow meters?

The flow meters (or) obstruction meters are generally mechanical type, which is classified into following methods.

(a) Orificemeter, (b) Venturimeter

(c) Variable area meter (or) Rotameter and, (d) Flow Nozzle

4.47 What is orificemeter?

An orificemeter is a simple device used for **measuring discharge** of fluid through a pipe. It works on the basis of Bernoullis equation like venturimeter.

4.48 What is venturimeter? How will you measure flow rate using Venturimeter?

When a venturimeter is placed in a pipe carrying the fluid whose flow rate is to be measured, a pressure drop occurs between the entrance and throat of the venturimeter. This pressure drop is measured using a differential pressure sensor and when calibrated this pressure drop becomes a measure of flow rate.

4.49 What are the applications of venturimeter?

- ❖ It is used where high pressure recovery is required.
- ❖ Can be used for measuring flow rates of water, wastes, gases, suspended solids, slurries and dirty liquids.
- ❖ Can be used to measure high flow rates in pipes having diameters in a few meters.

4.50 What are the main parts of Rotameter?

The main parts of a rotameter are as follows:

- ❖ A tapered transparent glass tube graduated to read flow rate directly.
- ❖ A float whose density is greater than that of the flowing fluid. The float diameter is such that it completely blocks the inlet of the tapered transparent glass tube.

4.51 What is pitot tube?

Pitot-tube is a device used for measuring the velocity of flow at any point in a pipe or a channel. It is based on the principle that if the velocity of flow at a point becomes zero, the pressure is increased due to the conversion of the kinetic energy into pressure energy.

4.52 What is temperature?

It is a numerical measure of hot and cold bodies. Its measurement is done by detection of heat transfer. Temperature is one of the most frequently used parameters for measurement and controlling of industrial processes.

4.53 What are the types of Temperature Measuring Instruments?

The types of temperature measuring instruments are

1. Bimetallic strip thermometer
2. Thermocouples
3. Thermometer
4. Thermistors
5. Pyrometers
6. Resistance Temperature Detectors

4.54 What is meant by thermocouple?

A thermocouple is a device made of two different wires joined at one end, called junction end. The two wires are called thermoelements.

4.55 What are the advantages of thermocouple?

The Advantages of Thermocouple are

- Rugged and inexpensive
- Simple construction
- Reasonably short response time
- High Accuracy
- Used to measure the temperature ranges of 1000°C

4.56 What are the factors used for Selecting Thermocouple?

The following criteria are used in selecting a thermocouple:

- Temperature range
- Abrasion and Vibration Resistance
- Chemical Resistance of the thermocouple

4.57 What are the advantages of RTD?

The Advantages of RTD are

- Good stability at high temperature
- Fast response
- No drift over long period
- High accuracy and good reproducibility
- Interechangable sensors

4.58 How Thermistors are classified?

Thermistors are classified as follows:

1. According to the temperature co-efficient

(a) Positive Temperature Co-efficient (PTC) Thermistor

(b) Negative Temperature Co-efficient (NTC) Thermistor

2. According to the Construction

(a) Bead thermistor

(b) Washer thermistor

(c) Disc thermistor

(d) Rod thermistor

(e) Probe thermistor

4.59 What are the advantages of thermistors?

The Advantages of thermistors are

- High sensitivity and fast response than RTD.
- Low cost and increased stability with age.
- They are very reliable and convenient to use.
- They are smaller in size as compared to thermocouples.
- Unlike thermocouples which provide milli volt outputs, use of thermistor results in reasonable output voltages.

4.60 What are the different types of Pyrometer?

The different Types of Pyrometer are

1. Optical Pyrometers
2. Total Radiation Pyrometer
3. Infrared Pyrometer