

**MARIA COLLEGE OF ENGINEERING & TECHNOLOGY  
ATTOOR**

TWO MARKS QUESTIONS & ANSWERS

**DESIGN OF MACHINE ELEMENTS**

**Unit 1: STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**

1. Define design.

Design is a process of activities to gather all the information necessary to realize the designer's idea as real product.

2. What are the various phases of design process?

- (i) Recognition of need
- (ii) Definition of problem
- (iii) Synthesis
- (iv) Analysis and optimization
- (v) Evaluation
- (vi) Presentation

3. List some factors that influence machine design.

- (i) Strength and stiffness
- (ii) Surface finish and tolerance
- (iii) Manufacturability
- (iv) Economic and aesthetics
- (v) Working atmosphere
- (vi) Safety and reliability cost

4. Define optimization?

Optimization is the process of maximizing a desired quantity or minimizing the unwanted one.

5. What are the various optimization methods available?

- (i) Optimization by evaluation
- (ii) Optimization by intuition
- (iii) Optimization by trial & error
- (iv) Optimization by numerical algorithm

6. Describe material properties hardness, stiffness and resilience.

*Hardness* is the ability of material to resist scratching and indentation

*Stiffness* is the ability of material to resist deformation under loading.

*Resilience* is the ability of material to resist absorb energy and to resist shock and impact load.

7. What is an impact load? Give examples.

If the time load application is less than one third of the lowest natural period of vibration of the part, the load is called an impact load.

*Example:* Punching presses, hammers, loads exerted on cams during the motion due to eccentricity, loads imposed on gear teeth due to irregular tooth profile.

8. Define principal plane and principal stresses?

A plane where only normal stresses act, with no shear stress acting is called principal plane. The (normal) stress acting on this plane is called principal stresses.

9. Define factor of safety?

The ratio between maximum stresses to working stress is known as factor of safety.

$$\text{Factor of safety} = \frac{\text{Maximum stress}}{\text{working stress}}$$

10. What are the factors to be considered in the selection of material for a machine element?

- a. Required material properties
- b. Manufacturing ease
- c. Material availability
- d. Cost

11. Why normal stress theory is not suitable for ductile materials?

Ductile materials mostly fail by shearing. But this theory considers only tensile or compressive stresses. So this is not suitable for ductile materials.

12. State the various methods of finding stresses concentration factors?

- a. Photo elasticity method
- b. Grid method
- c. Brittle coating method
- d. Strain gauge method
- e. Finite element techniques

13. Give some methods of reducing stress concentration?

- a. Avoiding sharp corners
- b. Providing fillets
- c. Use of multiple holes instead of single holes\

14. What are the factors that affect notch sensitivity?

- a. Materials
- b. Notch radius
- c. Size of component
- d. Type of loading
- e. Grain Structure

15. What are the types of variable stresses?
- Completely reverse or cyclic stresses
  - Fluctuating stresses
  - Repeated stresses
  - Alternating stresses

16. What are the various theories of failure?
- Maximum principal stress theory
  - Maximum shear stress theory
  - Maximum principal strain theory
  - Maximum strain energy theory

17. Explain size factor in endurance strength?

Size factor is used to consider the effect of the size on endurance strength. A large size object will have more defects compared to a small one. So endurance strength is reduced. If  $K$  is the size factor,

$$\text{Actual endurance strength} = \text{theoretical endurance limit} \times K$$

18. What are the methods used to improve fatigue strength?
- Cold working like shot peening, burnishing
  - Heat treatments like induction hardening
  - Pre stressing

19. What is an S-N curve?

An S-N curve has fatigue stress on Y- axis and number of loading cycles in X- axis. It is used to find the fatigue stress value corresponding to a given number of cycles.

- 20 What is low and high cycle fatigue?

Fatigue within  $10^3$  cycles is known as low cycle fatigue. Fatigue at high number cycles is called high cycle fatigue.

## UNIT 2 DESIGN OF SHAFTS AND COUPLINGS

- 1 What is a shaft?

A shaft is a rotating machine element, which transmits power from one point to another point.

- 2 What are the types of shaft?

Line shaft  
Spindle  
Stub shaft  
Counter shaft

- 3 What are the types of rigidity?

Torsional rigidity  
Lateral rigidity

4 Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight?

Stresses are maximum at the outer surface of a shaft. A hollow shaft has almost all the material concentrated at the outer circumference and so has a better strength and stiffness for equal weight.

5 Why is maximum shear stress theory used for shaft?

Since, the shaft is made of ductile material; maximum shear stress thus is used

6 What is the significance of slenderness ratio in shaft design?

If slenderness ratio is increased the shaft deviates from its “stub” behavior and it is essential to consider buckling while designing the shaft.

7 Define the term critical speed?

The speed at which the shaft runs so that the additional deflection of the shaft from the axis of rotation becomes infinite, is known as critical speed

8 What is a key?

A key is a device which is used for connecting two machine parts for preventing relative motion of rotation with respect to each other.

9 What are the types of key?

Saddle key  
Tangent key  
Sunk key  
Round key and taper pins.

10 What is the main use of woodruff keys?

A woodruff key is used to transmit small value of torque in automotive and machine tool industries. The keyway in the shaft is milled in a curved shape whereas the key way in the hub is usually straight.

11 What types of stress are developed in the key?

Shear stress and crushing stress

12 Classify crankshafts.

Single throw crankshafts  
Multi throw crankshafts

13 What are functions of crankshafts?

Crankshafts are used to convert rotary motion into reciprocating motion.

14 What are the materials used for crankshafts?

For I C engine or mild steel and automobile.

15 What is coupling?

The elements which join two shafts are coupling. It is used to connect sections of long transmissions shaft to the shaft of a driving machine. Couplings are used to connect sections of long transmission shafts and to connect the shaft of a driving machine to the shaft of a driven machine.

16 What is the function of a coupling between two shafts?

Couplings are used to connect sections of long transmission shafts and to connect the shaft of a driving machine to the shaft of a driven machine.

17 Under what circumstances flexible couplings are used?

They are used to join the abutting ends of shafts when they are not in exact alignment.

They are used to permit an axial misalignment of the shafts without under absorption of the power, which the shafts are transmitting

18 Where are flexible couplings used?

Vehicle  
Stationery machinery  
Automotive drives  
Machine tools

19 What is the material used for flange or flange coupling?

Cast iron

20 What is the advantage of gear coupling?

Gear coupling is a grid coupling with some flexibility because of using curved external teeth

Strength of gear coupling is very high.

Most compact coupling for high power transmission.

### UNIT-3

1 What are the purposes of screws?

To secure members  
To transmit power

2 What is a stud?

A stud is a bolt in which the head is replaced by a threaded end. It passes through one of the parts to be connected and is crewed into the other part.

3 How is bolt designated?

A bolt is designated by a letter M followed by nominal diameter and pitch in mm.

4 How is a bolt designated? Give example.

A thread is designated with  
Letter M followed by  
Nominal diameter in mm and  
Pitch in mm [for fine pitches only]  
 $Md \times p$

If coarse pitches are used then P value is omitted. Thus  $M20 \times 2.5$  means,  
Nominal diameter is 20mm  
2.5mm pitch, fine thread.

$M20$  means, 20mm nominal diameter with coarse threads.

5 What is the meaning of bolt  $M24 \times 2$ ?

Bolt nominal diameter,  $d=24$ mm and bolt pitch,  $p=2$ mm

6 State the advantages of threaded joints?

High clamping  
Small tightening force requirement  
Easy manufacturing  
Simple design

7 Define the term self locking of power screws?

If the friction angle is greater than helix angle of the power screw, the torque required to lower the load will be positive, indicating that an effort is applied to lower the load. This type of screw is known as self locking screw. The efficiency of the self locking screw is less than 50%.

8 Define welding?

Welding can be defined as a process of joining two similar or dissimilar metals with or without application of pressure along with or without addition of filler material.

9 Why are welded joints preferred over riveted joints?

Material is saved in welded joints and hence the machine element will be light if welded joints are used instead of riveted joints. Leak proof joints can be easily obtained by welded joints compared riveted joints.

10 How is welding classified?

1. Forge welding
2. Electric resistance welding
3. Fusion welding

11 What are the types of welded joints?

1. Butt joints
2. Lap joints
3. T joints
4. Corner joints
5. Edge joints

12 Define butt and lap joint?

1. Butt joint is made by welding the ends or edges of two plates.
2. Lap joint is made by two plates are overlapping each other for a certain distance. Then welded. Such welding is called fillet weld.

13 Define Tee joint and corner joint?

T joint: the two plates are arranged in shape which means the plates are located at right angles to each other.

Corner weld: Two plates are arranged at right angles such that it forms an angle.

14 When will the edge preparation need?

If the two plates to be welded have more than 6mm thickness, the edge preparation should be carried out.

15 What is the minimum size for fillet weld? If the required weld size from strength consideration is too small how will you fulfill the condition of minimum weld size?

It is the defined as the minimum size of the weld for a given thickness of the thinner part joined or plate to avoid cold cracking by escaping the rapid cooling.

16 When will the weld deposit be weaker?

When the components are made of high carbon steel or alloy steel, the weld becomes weaker.

17 What is a rivet?

A rivet is a round bar provided with a head on one side and a tail on the other side.

18 What are the different working processes used for making riveting?

1 Cold riveting 2 hot riveting

19 Name the possible modes of failure of riveting joint.

1. Crushing of rivets
2. Shear of rivets
3. Tearing of the plate at the edge
4. Tearing of the plate between rivets.

20 Define circumferential joint.

The ends of the plates are joined to the required length of the shell and to close its ends.

#### **Unit 4: DESIGN OF ENERGY STORING ELEMENT**

1. 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.

2. What are the applications of spring?

- (i) Automobiles
- (ii) Railway wagons.
- (iii) Valves and
- (iv) Watches

3. State any two functions of springs.

- (i) To measure forces in spring balance meters and engine indicators
- (ii) To store energy

4. What are the various types of springs?

- (i) helical spring
- (ii) spiral spring
- (iii) leaf spring

5. Classify the springs.

- (i) Close coiled or tension helical spring
- (ii) Open coil or compression helical spring

6. How will you find whether the given helical spring is a compression spring or tension spring?

Ends of compression springs are flat whereas for tension springs hooks will be provided at the ends. Coil will be slightly open to compression in a compression spring whereas in tension spring coil are very close.

7. What are conical springs?

It is made of round wire wound in the shape of cone.

8. What is spring index?

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

9. What are active coils?

Those coils which are free to deflect under load called active coil.

10. What are the end conditions of the spring?

- (i) plain end
- (ii) plain and ground end
- (iii) squared end
- (iv) Squared and ground end.

11. What is fly wheel?

Fly wheel is a machine element used to minimize the fluctuation of speed in an engine.

12. What is the function of the fly wheel?

A fly wheel used in machine service as reservoir which stores energy during the period when the supply of energy is more than the requirement and releases it during the period when the requirement of energy is more than the supply.

13. What is the application of flywheel?

In some cases the power is supplied at uniform rate. While the requirement of power from the driven machinery is variable. Eg: punching press driven by the electric motor, rolling mill driven by an electric motor. In this case the flywheel store energy during the idle portion of the work cycle by increasing its speed and delivers this energy. During the peak load period of punching.

14. State any two type of flywheel.

- (i) Disc type
- (ii) Web type.

15. What is flywheel effect?

The mass moment of inertia required for the fly wheel is termed as flywheel effect.

16. Define coefficient of fluctuation of speed in the case of flywheel?

Coefficient of fluctuation of speed is the ratio of maximum change of speed to mean speed of the flywheel.

17. Define the term fluctuation of energy.

The ratio of fluctuation of energy to the mean energy is called coefficient of fluctuation of energy.

18. State the type of stresses induced in a rim flywheel?

- (i) tensile stress due to centrifugal force
- (ii) tensile bending stress caused by restraint of the arms and
- (iii) The shrinkage stresses due to unequal rate of cooling of casting.

19. What are the stresses induced in flywheels arms?

- (ii) tensile stress due to centrifugal force
- (iii) bending stress due to torque
- (iv) stress due to belt tension

20. How does the function of flywheel differ from that of governor?

A governor regulates the mean speed of an engine when there are variations in the mean loads. It automatically controls the supply of working fluid to engine with the varying load condition and keeps the mean speed within the limits. It does not control the speed variation caused by the varying load. A flywheel does not maintain constant speed.

## UNIT 5

### DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS

1 What is bearing?

Bearing is a stationary machine element which supports a rotating shafts or axles and confines its motion.

2 State the components of rolling contact bearings?

- 1. Outer race
- 2. Inner race
- 3. Rolling element
- 4. Retaining cage

3 Classify the roller bearings?

- 1. Cylinder roller bearings
- 2. Needle roller bearing
- 3. Taper roller bearing

4 List any four advantages to rolling contact bearings over sliding contact bearings?

- 1. Starting friction is low

2. Lubrication is simple
3. It requires less axial space and more diametric space
4. Heavier loads and higher speeds are permissible

5 State the advantages of thrust ball bearing?

1. High initial cost
2. Less capacity to withstand shock
3. Noisy operation at very high speed
4. Life is finite
5. Design of bearing housing is complicated

6 what is load rating?

The load carrying capacity of a rolling element bearing is called load rating.

7 Explain the term Dynamic load carrying capacities of rolling contact bearing?

Dynamic load rating is defined as the radial load in radial bearings that can be carried for a minimum life of one million revolutions.

8 List any six types of bearing materials?

1. Lead base babbitt
2. Tin base babbitt
3. Leaded bronze
4. Copper lead alloy
5. Gun metal
6. Phosphor bronze

9 What is the advantage of Teflon which is used for bearings?

Teflon has high fatigue strength, hardness and more resistant to abrasive.

10 What is journal bearing?

A journal bearing is a sliding contact bearing which gives lateral support to the rotating shaft.

11 What are types of journal bearings depending upon the nature of contact?

1. Full journal bearing
2. Partial bearing
3. Fitted bearing

12 What are the types of journal bearing depending upon the nature of lubrication?

1. Thick film type
2. Thin film type

3. Hydrostatic bearings
4. Hydrodynamic bearing

13 What is known as self acting bearing?

The pressure is created within the system due to rotation of the shaft known as self acting bearing.

14 What are seals? What are the main types of seals?

Seals and gaskets are elements used to control or prevent leakage from a controlled environment.

Types are static seals, dynamic seals

15 How is "O" ring designated?

An "O" ring is designated as "internal diameter  $\times$  thickness"

16 What is a connecting rod?

Connecting rod is a machine member, which used to transmit power from a reciprocating member to rotary one or vice versa.

17 What are materials used for connecting rod?

Mild steel and alloy of aluminum for light duty. Alloy steels of molybdenum and chromium are used for heavy duty.

18 What are the stresses set up in an IC engine connecting rod?

1. Tensile stress
2. Compressive stress
3. Bending stress due to inertia force.

19 What type of external forces act on connecting rod?

The external forces acting on connecting rod are

1. Forces due to gas or steam pressure and inertia of reciprocating parts
2. Inertia forces.

20 Why I- section is chosen for the connecting rod?

The "I" section of the connecting rod is used due to its lightness and to keep the inertia forces as low as possible. It can also with stand high gas pressure.

