DESIGN OF MACHINE ELEMENTS
UNIVERSITY QUESTION BANK WITH ANSWERS

Unit 1

STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS

1.Define factor of safety.

Factor of safety (FOS) is defined as the ratio between the maximum stress and working stress.

2.What are the various phases of design process?

Recognition of need
Definition of problem
Synthesis
Analysis and Optimization
Evaluation
Presentation

3.List out the factors involved in arriving at factor of safety.

Material properties
Nature of load
Presence of localized stress
Presence of initial stress
Mode of failure

4.Define Endurance limit.

Endurance limit is the maximum value of completing reversed stress that can sustain an infinite number (10^6) of cycles without failure.

5.What are the factors affecting endurance strength of a material?

Load
Surface finish
Size
Temperature
Impact
Reliability

6.What is eccentric load and eccentricity?

An external load, whose line of action is parallel but does not coincide with the centroidal axis of the machine component, is known as an eccentric load. The distance between the centroidal axis of the machine component and the eccentric load is called eccentricity. (Ex.) C-clamps, Punching machines, brackets, offset connecting links etc.

7.What is stress concentration and stress concentration factor?

The irregularity in stress distribution caused by abrupt changes of form is called stress concentration.
Stress concentration factor = maximum stress at the change of cross section / nominal stress.

8.What are the factors affecting selection of material for machine element?

Load applied
Purpose and operating conditions of the part.
Suitability for manufacture.
Minimum weight and optimal size
Availability and cost.

9.Define Resilience.

Resilience is the property of the material to absorb energy and to resist shock and impact
load This property is essentia for spring materials.

10. Define the Morphology of Design.

Morphology of design consisting of problem formulation analysis search for alternative an
evaluation decision taking and specification of the solution.

11.What are the various theories of failure?

a. Maximum principal   theory
b. Maximum shear stress theory
c.Maximum   principal   strain   theory
d. Maximum strain energy theory

12. 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.

13.What is an impact load? Give examples

If the time load application is less than one third of the lowest national 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

14.What are the types of fracture?

Ductile fracture Brittle fracture

15.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,
Actual endurance strength = Theoretical endurance limit x K

Unit 2

SHAFTS AND COUPLING

1.What are various types of stresses induced in the shafts?

Shear stresses due to transmission of torque.
Bending stresses.
Stresses due to combined torsional and bending loads.

2.What is a flange coupling?

It is a coupling having two separate cast iron flanges. Each flange is mounted on the shaft end and keyed to it. The faces are turned up at right angle to the axis of the shaft. One of the flanges has a projected portion and the other flange has a corresponding recess. This helps to bring the shafts into line and maintain alignment.

3.What is the effect of keyway cut into the shaft?

The keyway cut into the shaft reduces the load carrying capacity of the shaft. This is due to the stress concentration near the corners of the keyway and reduction in the cross sectional area of the shaft. In other words the torsional strength of the shaft is reduced.

4.What is the difference between coupling and a clutch?

A coupling is a device used to make permanent or semi permanent connection where as a clutch Permits rapid connection or disconnection at will of the operator.

5.How hollow shaft are superior to solid shaft?

The weight of hollow shaft is 75% less then solid shaft for same torque transmission

6.Define Preferred Numbers?

Preferred Numbers from a general basis for standardizing and grding a series of simulator dimension characteristics or articles

7.Is what situation flexible coupling are used?

The flexible coupling is employed to tolerate lateral and angular misalignment of the shafts.

8.What are the various factors involved in good shaft coupling?

It should be easy to connect or disconnect
It transmit full power of the shaft

9.What types of stresses are developed in the key?

Shear stress
Crushing stress

10.Why a hallow shaft has great strength and stiffness then solid shaft of equal weight?

The weight of hollow shaft is 75% less then solid shaft for same torque transmission.

11.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 or whirling speed.

12.Factor is considered to design shaft
    i. strength
    ii. stiffness

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

14.What are the types of keys?
Saddle key
Tangent key
Sunk key
Round key and taper pins

15.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. If the friction angle is greater that the helix angle of the power screw, the torque required lowering 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. This efficiency of the self locking screw is less than 50%.

TEMPORARY AND PERMANENT JOINTS

1.What is meant by single start and double start thread?

Single-start means that there is only one "ridge" wrapped around the cylinder of the screw's body. Each time that the screw's body rotates one turn (360^0)' it has advanced axially by the one pitch distance. "double-start"that there is are two "ridge" wrapped around the cylinder of the screw's body. Each time that the screw's body rotates one turn (360^0)' it has advanced axially by the two pitch distance.

2.List the advantages and disadvantages of threaded fasteners.

Advantage:

Screwed joints are highly reliable in operation

Screwed joints are convenient to assemble and dis assemble

Disadvantage:

The stress concentration in the threaded portions which are vulnerable points under variable load conditions.

3.Write the advantages of welded joints over the riveted joints.

It is assumed that the tensile stress is distributed uniformly across the section of the butt weld.

It is assumed that the shear stress in a parallel fillet weld is uniformly distributed along the entire length of the weld.

Stress situation in a fillet weld is complicated because of bending action of the force.

4.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.

5.How is bolt designated?

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

6.State the advantages of threaded joints?

High clamping

Small tightening force requirement

Easy manufacturing

Simple design

7.How is welding classified?

Forge welding

Electric resistance welding

Fusion welding

8.Name the possible modes of failure of riveting joint.

Crushing of rivets

Shear of rivets

Tearing of the plate at the edge

Unit 4

ENERGY STORING ELEMANTS AND ENGINE COMPONENTS

1.Define surging of springs.
The spring material is subjected to higher stresses, which may cause early fatigue failure of springs. This effect is called as surging of springs.

2.Define mechanical advantage of a lever.
It is the ratio of load lifted to the effort applied.

3.Define Resilience of a spring.
It is the amount of energy absorbed by the spring per unit deflection.

4.Define free length of spring?
It is length of spring is the free or unloading condition.

5.What is the function of a flywheel?
A flywheel is a machine member serves a 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.

6.Define co-efficient of fluctuation of energy in a flywheel.
It is the ratio of fluctuation of energy to the work done per cycle.

7.Define free length of a spring?
It is length of spring is the free or unloading condition.

8.State any two important applications of leaf spring?
The leaf springs are commonly used in automobile.

9.Define : Leaf springs
A leaf spring consists of flat bars of varying lengths clamped together and supported at both ends, thus acting as a simply supported beam.

10.What are the stresses induced in flywheel arms?
☐ Tensile stress due to centrifugal force.
☐ Bending stress due to Torque.
☐ Stress due to belt tension.
☐ Specify the types of flywheel.
Solid piece flywheel.
a. Web type   b. Rim and hub type.
Split wheel
a. Rim and hub type only

11.Classify the helical springs.

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

12.What are the various types of springs?

      Helical springs
      Spiral springs
      Leaf springs
      Disc spring or Belleville springs

13.State any two functions of springs.

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

14.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.

Unit 5
BEARINGS

1.Classify the bearings.

- Based on nature of contact between bearing surfaces.
  - Sliding contact bearing.
  - Rolling contact (or) Antifriction bearing.
- Based on load applied.
  - Radial bearing (Circumferentially loaded)
  - Thrust bearing (Axially loaded)

2.What is the advantage of Teflon which is used for bearing?

- It has lower co efficient of friction
- It can be used at high temperature
- It is practically chemically inert
- It is dimensionally stable

3.What are the stresses induced in flywheel arms?

Tensile stress due to centrifugal force.
Bending stress due to Torque.
Stress due to belt tension.
Specify the types of flywheel.
Solid piece flywheel.
a. Web type   b. Rim and hub type.
- Split wheel
a. Rim and hub type only

4.Name the type of lubricant used in journal bearing?

- Graphite
- Grease
- Mineral oil and synthetic oil

5.What is the function of a flywheel?

A flywheel is a machine member serves a 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.

6. Specify the types of lubricant with example.

- Liquid lubricants   - Mineral and synthetic oils.
- Semisolid lubricants - Grease ,
- Solid lubricants   - Graphite

7. State the merits of hydrostatic bearing.

The hydrostatic bearing steady loads without any relative motion between the journal and the Bearing.

8. Define co-efficient of fluctuation of energy in a flywheel.

It is the ratio of fluctuation of energy to the work done per cycle.

9. What are the bearing materials?

Aluminium Alloy, Copper alloy, Babbit, Cast iron steel, Silver etc.

10. State the different failure theories and the type of materials for which these are applicable?

Maximum principal theory –brittle material.
Shear Stress Theory –Ductile Material.

11. What is known as self – acting bearing?

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

12. What is flywheel?

Flywheel is a machine elements used to minimize the fluctuation of speed in an engine.

13. What is the function of flywheel?

A flywheel used in machine serves as a reservoir which stores energy during the period when the supply of energy is more than the requirement and releases it dulling the period when the requirement of energy is more than the supply.

14. Define the term 'fluctuation of speed' and 'fluctuation of energy'.

The ratio of maximum fluctuation of speed to the mean speed is called co efficient of fluctuation of speed. The ratio of fluctuation of energy to the mean energy is called coefficient of fluctuation of energy.

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

Tensile stress due to centrifugal force
Tensile bending stress caused by the restraint of the arms and
The shrinkage stresses due to unequal rate of cooling of casting.