KCG COLLEGE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

CE 6306-STRENGTH OF MATERIALS (SEM: 3)

QUESTION BANK FOR UNIT 3

PART-A (2 Marks)

1. ***Write down the expression for the power transmitted by a shaft***

   $P=\frac{2\pi NT}{60}$ N-speed in rpm, T-torque in N-m, P-power transmitted in watts

2. ***List the loads normally acting on a shaft***
   - Bending load
   - Torsional load or twisting load
   - Axial thrust

3. ***What do you mean by equivalent twisting moment***

   When a shaft is subjected to twisting and bending moment, the resultant twisting moment is called equivalent twisting moment. It is denoted by T_e.

4. ***Define Torque.***

   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 torsion moment or simply as torque.

5. ***What is a composite shaft***

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

6. ***Why are hollow circular shafts 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.

7. ***What do you mean by strength of a shaft?***

   The maximum torque that a shaft can transmit is called strength of the shaft.

8. ***What do you mean by torsional stiffness?***

   Torsional rigidity or stiffness of the shaft is defined as the product of modulus of rigidity G and polar moment of inertia of the shaft.

   Torsional rigidity = GJ = T× (L/ θ)

9. ***What do you mean by equivalent twisting moment?***

   When a shaft is subjected to twisting and bending moment, the resultant twisting moment is called equivalent twisting moment. It is denoted by T_e.

   $$Te = \sqrt{T^2 + M^2}$$

10. ***State any four assumption involved in simple theory of torsion***
    i. The material of the shaft is homogenous, perfectly elastic and obeys Hookes's law.
    ii. Twist is uniform along the length of the shaft
    iii. The stress does not exceed the limit of proportionality.

11. Differentiate between close coiled and open coiled helical spring and state the type of stress induced in each spring due to an axial load.

Open Coiled Spring	*Closed Coiled Spring*
The spring wires are closed very closely, each turn is nearly at right angles to the axis of helix.	The wires are coiled such that ther is a gap between the two consecutive turns
Helix angle is less than 10°	Helix angle is large (>10°)

12. State any two functions of spring

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

13. What is meant by stiffness of spring

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

$K = \frac{w}{\delta}$ w- load; δ- deflection

14. What are the various types of spring

- Helical spring
- Spiral spring
- Leaf spring
- Disc spring or Belleville spring

15. A close coiled helical spring is to carry an axial load of 500 N. Its mean coil diameter is to be times is to be 10 times its wire diameter. Calculate this diameter if the maximum shear stress in the material is to be 80 MPa.

Maximum shear stress, $\tau = 16WR / \pi d^3$

$80 = 16 \times 500 \times (10d/2)$

d= 12.6 mm say d=13 mm

16. 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.

17. What is a leaf spring?

The laminated carriage springs are called leaf springs.

They are two types, namely (i) semi-elliptical type and (ii) quarter-elliptical type.

18. 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.

19. Name the two important types of helical springs?

(i) Close- coiled or tension helical spring.

(ii) Open –Coiled or compression helical spring.

20. Define pitch.

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

Pitch = Free Length / n-1

Part-B (16 Marks)

1. A solid circular shaft transmits 75 KW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1^0 in 2 m length if shaft and shear stress is limited to 50 N/mm^2. Take modulus of rigidity C=1x10^5 N/mm^2

2. Derive the torsion equation for a solid circular shaft of diameter ‘d’ and length ‘l’ which is fixed at one end and subjected to a torque of intensity ‘T’ at the free end.
3. A solid aluminum shaft 1m long and 100 mm diameter is to be replaced by hollow steel shaft of the same length and same external diameter. The angle of twist per unit torsional moment over total length is same for both the shafts. If the modulus of rigidity of steel is thrice that of aluminum, find the inner diameter of the steel shaft.
4. The stiffness of a close coiled helical spring is 15 N/mm of compression under a maximum load of 60 N. the maximum shearing stress produced in the wire of the spring is 125 N/mm^2. The solid length of the spring is given as 5 cm. find
   i. Diameter of wire
   ii. Mean diameter of the coils and
   iii. Number of coils required. Take C=4.5x10^4 N/mm^2
5. Derive a relation for deflection of a closely coiled helical spring subjected to an axial downward load W.
6. An open coiled helical spring of wire diameter 12 mm, mean coil radius 84mm, helix angel 20 degrees carries an axial load of 480 N. determine the shear stress and direct stress developed at inner radius of the coil.