

Total Marks: 80

Time: 3 Hours

1. Question No. 01 is compulsory
2. Attempt any three question from the remaining.
3. Assumption made should be clearly stated.
4. Use of standard Design Data Book like PSG, Mahadevan is permitted.

- Q1. Solve (Any four). 20**
1. Explain about Preferred Numbers.
 2. State the different theories of failure and explain any two in details.
 3. What are different types of spring? What are different materials?
 4. Explain overhauling of screw and self-locking of screw.
 5. What do meant by Ergonomics and Aesthetic values in machine design?
- Q2 A) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. 15**
- B) What is cotter? Why taper is provided on the cotter? 05**
- Q3 A) i. What is Stress concentration? What are various causes of stress concentration? 05**
- ii. Explain about Notch sensitivity & Endurance Limit 05**
- B) A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. 10**
- Q4 A) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows: 12**
- (a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
- (b) The allowable shear stress for cast iron is 15 MPa.

- (c) The allowable bearing pressure for rubber bush is 0.8 N/mm².
- (d) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling.

B) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm². **08**

Take Wahl's factor, $K = \frac{4C - 1}{4C - 4} + \frac{0.615}{C}$, where C = Spring index.

Q5 **A)** A shaft is supported on bearings A and B, 800 mm between centres. A 20° straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left hand bearing A, and a 700 mm diameter pulley is mounted 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of wrap. The pulley also serves as a flywheel and weighs 2000 N. The maximum belt tension is 3000 N and the tension ratio is 3:1. Determine the maximum bending moment and the necessary shaft diameter if the allowable shear stress of the material is 40 MPa. **15**

B) Explain various types of keys. **05**

Q6 **A)** A power transmission screw of a screw press is required to transmit maximum load of 100 kN and rotates at 60 r.p.m. Trapezoidal threads are as under : **12**

| | | | | |
|----------------------------|------|------|------|------|
| Nominal dia, mm | 40 | 50 | 60 | 70 |
| Core dia, mm | 32.5 | 41.5 | 50.5 | 59.5 |
| Mean dia, mm | 36.5 | 46 | 55.5 | 65 |
| Core area, mm ² | 830 | 1353 | 2003 | 2781 |
| Pitch, mm | 7 | 8 | 9 | 10 |

The screw thread friction coefficient is 0.12. Torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine motor power required to drive the screw. Maximum permissible compressive stress in screw is 100 MPa.

B) i. What is nipping in Leaf spring? **05**

ii. Discuss on various types of threads used for power Screw. **03**
