

6. When a nut is tightened by placing a washer below it, the shank of bolt is subjected to CO3- R
- (a) Direct shear stress (b) Torsional shear stress
(c) Tensile stress (d) Compressive stress
7. When a helical spring is cut into two equal halves, stiffness of each of the resulting spring will be CO4- R
- (a) Unaltered (b) Double (c) One half (d) One fourth
8. Energy is stored in a flywheel in the form of CO4- R
- (a) Heat energy (b) Solar energy (c) Kinetic energy (d) Potential energy
9. In radial bearings, the load acts CO5- R
- (a) Along the axis of rotation (b) Perpendicular to the axis of the rotation
(c) Parallel to the axis of rotation (d) Inclined to the axis of rotation
10. The rolling contact bearings are known as CO5- R
- (a) Thick lubricated bearings (b) Plastic bearings
(c) Antifriction bearings (d) Thin lubricated bearings

PART – B (5 x 2= 10Marks)

11. Define factor of safety. CO1- R
12. List the various failures occur in sunk key. CO2- U
13. Mention the advantages of screwed fasteners. CO3- R
14. Classify the types of helical springs. CO4- R
15. Infer the desired properties of bearing materials. CO5- U

PART – C (5 x 16= 80Marks)

16. (a) An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm² in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take $E = 200 \text{ kN/mm}^2$. CO1- App (16)
- Or
- (b) A mass of 50Kg drops through 25mm at the center of a 250mm long simply supported beam. The beam has square cross section. It is made of steel 30C8 ($S_{yt}=400\text{N/mm}^2$) and FOS is 2. The modulus of elasticity is 207GPa. Determine the dimension of the cross section of the beam. CO1- App (16)

17. (a) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2000 N-m to -800 N. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. CO2- App (16)

Or

- (b) Design a muff coupling to connect two steel shafts transmitting 25kW power at 360rpm. The shafts and key are made of plain carbon steel 30C8 ($S_{yt}=S_{yc}=400\text{N/mm}^2$). The sleeve is made of grey cast iron FG200 ($S_{ut}=200\text{N/mm}^2$). The factor of safety for the shafts and key is 4. For sleeve, the factor of safety is 6 based on ultimate strength. CO2- App (16)
18. (a) It is required to design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50kN. The rods are coaxial and small angular movement between their axes is permissible. Design the joint and specify the dimensions of its components and select suitable materials for the parts. CO3- App (16)

Or

- (b) A cylindrical pressure vessel with 1 m inner diameter is subjected to internal steam pressure of 1.5 MPa. The permissible stresses for the cylinder plate and the rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. The efficiency of longitudinal joint can be taken as 80% for the purpose of calculating the thickness. The efficiency of the circumferential lap joint and calculate. (i) thickness of the plate (ii) diameter of the rivet (iii) number of rivets (iv) pitch of rivets. CO3- App (16)
19. (a) It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30 mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire of grade 1. The constant A and m can be taken as 1753 and 0.182 respectively ($G = 81370 \text{ N/mm}^2$). The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate wire diameter, mean coil diameter, number of active coils and free length of the spring. CO4- App (16)

Or

- (b) A machine is driven by a motor, which exerts a constant torque. CO4- App (16)
The resisting torque of the machine increases uniformly from 500 N-m to 1500 N-m through a 360° rotation of the driving shaft and drops suddenly to 500 N-m again at the beginning of the next revolution. The mean angular velocity of the machine is 30 rad/s and the coefficient of speed fluctuations is 0.2. A solid circular steel disk, 25 mm thick, is used as a flywheel. The mass density of the steel is 7800 kg/m³ while poisson's ratio is 0.3. Calculate the outer radius of the flywheel disk and the maximum stresses induced in it.
20. (a) A single row deep groove ball bearing is subjected to a radial CO5- App (16)
force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L_{10th} of the bearing is 20000 hr. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for the application.
- Or
- (b) Determine the dimensions of the cross section of the connecting CO5- App (16)
rod for a diesel engine with following data: Cylinder bore = 100 mm; length of the cylinder rod = 350 mm; maximum gas pressure = 4Mpa; factor of safety = 6.