1. Find the diameter of a solid steel shaft to transmit 20 kW at 200 rpm. The ultimate shear stress for the steel may be taken as 360 MPa and factor of safety as 8.

If a hollow shaft is to be used in place of the solid shaft is to be used in place of solid shaft find the inside and outside diameter when the ratio of inside to outside diameter is 0.5.

1. A Commercial Steel shaft in required to sustain a torque of 450 Nm and a bending moment of 300 Nm. Determine the diameter of the solid shaft required and the angular deflection. Assume steady load and light shock.
2. A centrifugal pump is driven by an electric motor of 10 kW power at 1440 rpm. There is a reduction gearbox between the rotor and pump. The pump shaft rotates at 480 rpm. The design torque is 150% of the rated torque. The motor and pump shaft are made of plane carbon steel 40 C 8. Taking Shear strength as 55% of yield strength in tension and factor of safety of 4, calculate: (a) The diameter of motor shaft, (b) Diameter of pump shaft.
3. A pair of wheels of a railway wagon carries a load of 50 kN on each axle box, acting at a distance of 100 mm outside the wheel base. The gauge of the rails is 1.4 m. Find the diameter of the axle between the wheels, if the stress is not to exceed 100 MPa.
4. A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10 000 N-m. The shaft is made of 45 C 8 steel having ultimate tensile stress of 700 MPa and a ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft.
5. Compare the strength of a hollow shaft with that of a solid shaft of the same diameter and material of the diameter ratio is 0.75.
6. A 40 mm diameter shaft is made of steel with yield strength of 400 MPa. A parallel key of 12 mm wide and 8 mm thick made of steel with yield strength of 340 MPa is to be used. Find the required length of key. The shaft is loaded to transmit maximum permissible torque. Use maximum shear stress theory and assume a factor of safety 2.
7. A line shaft is driven by means of a motor placed vertically below it. The pulley on the line shaft is 1.5 metre in diameter and has belt tensions 5.4 kN and 1.8 kN on the tight side and slack side of the belt respectively. Both these tensions may be assumed to be vertical. If the pulley be overhang from the shaft, the distance of the centre line of the pulley from the centre line of the bearing being 400 mm, find the diameter of the shaft. Assuming maximum allowable shear stress of 42 MPa.
8. A steel spindle transmits 4 kW at 800 r.p.m. The angular deflection should not exceed 0.25° per metre of the spindle. If the modulus of rigidity for the material of the spindle is 84 GPa, find the diameter of the spindle and the shear stress induced in the spindle.