16 MARKS

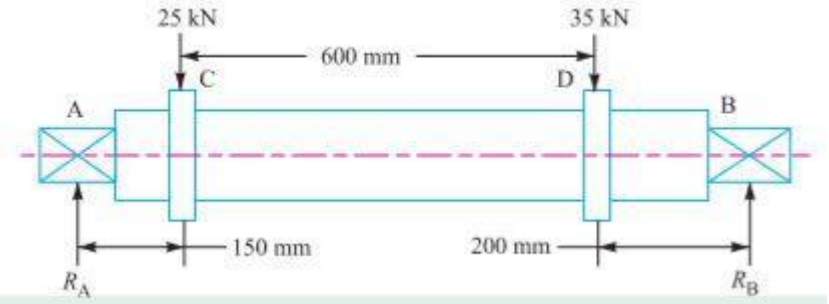
UNIT – 1

FUNDAMENTALS OF MACHINE DESIGN

1. A shaft is transmitting 100 kW at 160 rpm. Find a suitable diameter for the shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress at 70 MPa.
2. A shaft is transmitting 97.5 kW at 180 rpm. If the allowable shear stress in the material is 60 MPa. Find the suitable diameter for the shaft. The shaft is not to twist more than 1◦ in a length of 3 m. Take C = 80 GPa.
3. A hollow shaft is required to transmit 600 kW at 110 rpm, the maximum torque being 20% greater than the mean. The shear stress is not to exceeds 63 MPa and twist in a length of 3 m not to exceeds 1.4 degrees. Find the external diameter is 3/8. Take C = 84 GPa.

BENDING STRESSES IN BEAM

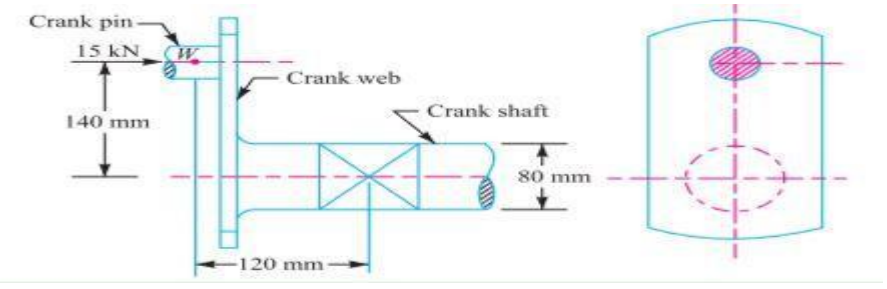
1. A pump lever rocking shaft is shown in figure. The pump lever exerts forces of 25 kN and 3kN concentrated at 150 mm and 200 mm from the left and right hand bearing respectively. Find the diameter of the central portion of the shaft, if the stress is not to exceed 100 MPa.



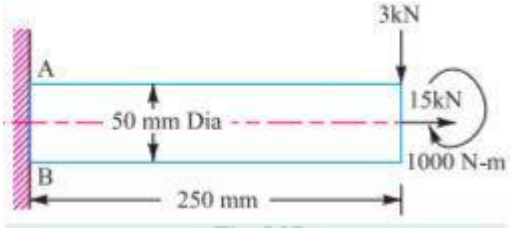
2. A cast iron pulley transmits 10 kW at 400 rpm. The diameter of the pulley is 1.2 m and it has four straight arms of elliptical cross section in which the major axis is twice the minor axis. Determine the dimensions of the arm, if the allowable bending stress is 15 MPa.

PRINCIPAL STRESS AND PRINCIPAL PLANE

1. A hollow shaft of 40 mm outer diameter and 25 mm inner diameter is subject to a twisting moment 120 Nm. Simultaneously it is subjected to an axial thrust of 10 kN and a bending moment of 80 Nm. Calculate the maximum compressive and shear stresses.
2. An overhang crank with pin and shaft is shown in figure. A tangential load of 15 kN acts on the crank pin. Determine the maximum principal stress and maximum shear stress at the centre of the crankshaft bearing.



3. A shaft, as shown in Fig. 5.17, is subjected to a bending load of 3 kN, pure torque of 1000 N-m and an axial pulling force of 15 kN. Calculate the stresses at A and B.



THEORIES OF FAILURES

1. A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kNm and a torsional moment 30 kNm. Determine the diameter of the shaft using two different theories of failure and assuming a FOS of 2. Take E = 210 GPa and Poisson ratio = 0.25.
2. A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 Nm and a torque T. If the yield point of the steel in tension is 200 MPa. Find the maximum value of this torque without causing yielding of the shaft according to the maximum principal stresses, the maximum shear stresses, the maximum distortion energy theory of yielding.
3. The load on a bolt consists of an axial pull of 10kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, maximum strain energy theory, maximum distortion energy theory. Take permissible tensile stress at elastic limit = 100 MPa and poisson's ratio = 0.3.