Q1. A single row 02 series deep groove ball bearing have bore diameter 60 mm and is used for a work cycle with 1000 rpm for one third of time, at 2000 rpm at another one third of time and at 4000 rpm for rest of the time. Assuming light shock load condition and a working load having combination of axial load 2 kN and radial load 3.5 kN, find the expected life in hours.

[10]

Q2. A cone clutch with asbestos friction liner (coefficient of friction 0.25 allowable maximum pressure intensity 0.25 MPa) is required to be designed to transmit 25 kW at 600 rpm. Assuming a semi cone angle 12.5º and outer diameter of friction liner as 250 mm, find the following under uniform wear condition:
   a) Inner diameter of friction lining
   b) Face width of friction lining
   c) Axial force required to engage the clutch.

[15]

Q3. The load on a steel plate having a machined step with fillet radius (Ref Fig. Q3) is tensile in nature. The load varies periodically between 50 kN to 100 kN. For the material, given that the notch sensitivity factor 'q' is 0.95, ultimate strength 480 MPa, endurance limit strength 240 MPa, yield strength under tension 300 MPa. Find, using Goodman criteria, the safety factor of the design under 99% reliability.

[10]

Q4. A journal bearing has 50 mm bore diameter and 80 mm length. The bearing pressure is 6 MPa. The journal rotates at 1000 rpm. The ratio of journal diameter to clearance is 1000. The oil used in the bearing has viscosity 0.015 kg/m.s at designed operating temperature of 75 ºC, while the room temperature is 25 ºC. Find:
   a) Artificial cooling load (in watts)
   b) Required coolant oil circulation if the specific heat of oil is 1900 J/kg/ºC and the difference in inlet and outlet oil temperature is 25 ºC
Given that the bearing casing is exposed to still air and has an area of about 25×10^3 mm^2.

[15]

Q5. A steel bracket mounted on wall is shown in Fig Q5. It is supported by three bolts as shown. Find the most critical bolt. The bolt material has allowable shear load 80 MPa, find the required bolt size.

[15]

Q6. A heavy duty leaf spring has 12 leaves, 2 of which are full length leaves. The spring supports (eyes) are 1.05 m apart and there is a tight central band of 85 mm width. The central load is 5.4 kN while the permissible stress in the spring material is 280 MPa. Find the thickness and width of the steel spring leaves and maximum deflection of the spring. Given that the ratio of the total depth to the width of the spring is 3.

[15]