Code No: R1622034 **R16** SET - 1

II B. Tech II Semester Regular/Supplementary Examinations, November - 2020
DESIGN OF MACHINE MEMBERS-I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A

1. a) List out the various phases of design process. (2M)
   b) What is modified Goodman's line? (3M)
   c) What do you understand preloading of bolts? (2M)
   d) What is key? State its function. (2M)
   e) Discuss the function of a coupling. (3M)
   f) The extension springs are in considerably less use than the compression springs. Why? (2M)

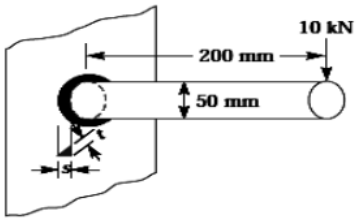
PART -B

2. a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, Calculate the maximum value of this torque without causing yielding of the shaft according to 1. The Maximum principle stress; and 2. The maximum shear stress. (7M)
   b) A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20kN and a maximum value of 50kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish of 0.9. The material properties of bar are given by ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 Mpa (7M)

3. a) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate strength according to 1. Modified Goodman relation; and 2. Soderberg relation. Take yield strength = 0.55Ultimate strength; Endurance strength= 0.5 Ultimate strength and factor of safety = 2. (7M)
   b) Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete stress reversal), σ_e = 265 MPa and a tensile yield strength of 350 MPa. The member is subjected to a varying axial load from W_{min} = -300×10^3 N to W_{max} = 700×10^3 N and has a stress concentration factor = 1.8. Use factor of safety as 2.0. (7M)
~~~~~~

4. a) A mild steel cover plate is to be designed for an inspection hole in the shell of a pressure vessel. The hole is 120mm in diameter and the pressure inside the vessel is 6 N/mm^2.Design the cover plate along with the bolts. Assume allowable tensile stress for mild steel as 60 MPa and for bolt material as 40 MPa. (7M)

   b) A 50mm diameter solid shaft is welded to a flat plate as shown in fig. if the size of the weld is 15 mm; Calculate the maximum normal and shear stress in the weld. (7M)



5. a) Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses: σt= 60 MPa; τ=70 MPa; and σc= 125 MPa. (7M)

   b) A hollow shaft of 0.5m outside diameter and 0.3m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings6m apart and it transmits 5600kW at 150 rpm. The maximum axial propeller shaft is 500kN and the shaft weighs 70kN. Determine(i).The maximum shear stress developed in the shaft(ii).The angular twist between the bearings. (7M)

6. a) Design a cast iron protective type flange coupling to transmit 15kW at 900 rpm from an electric motor to a compressor. The service factor may be assumed (s) is 1.35. The following permissible stresses may be used. Shear stress for shaft, bolt and key material=40MPa, Crushing stress for bolt and key=80 MPa, Shear stress for cast iron=8 MPa. (7M)

   b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15kW at 200 rpm and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for the shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14MPa. (7M)

7. a) At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb. The shock caused by the falling of the cage in case of a failure. The loaded cage weighs 75KN, while the counter weight has a weight of 15KN. If the loaded cage falls through a height of 50 meters from rest, find the maximum stress induced in each spring if it is made of 50mm diameter steel rod. The spring index is 6 and the number of active turn in each spring is 20. Modulus of rigidity G= 80KNmm^2. (7M)

   b) Discuss the materials and practical applications for the various types of springs. (7M)