National Institute of Technology, Hamirpur (H.P.)

B.Tech.- 3rd Year

End Semester Examination (Session 2020-21)

Branch: Mechanical Engineering **Semester:** 5th
Course Name: Machine Design-I **Course Code:** MED-311
Time: 2:00 hours **Maximum Marks:** 50

Instruction to candidates:

- **Mention page numbers on answer sheets and attempt all the questions in the order as they appear in the question paper.**
- **Scan all the answer sheets page-wise in the correct order and save/send the scanned file as per prescribed format: rollnosubjectcode.pdf No file other than .pdf will be evaluated.**
- **Assume if there are any missing data with little explanation.**
- **Use design data hand book.**
- **Keep your web-cameras on for invigilation purpose, if any student fails to keep the camera in ON mode he/she can be marked absent.**

1.

A bushed pin flexible flange coupling transmits 30 kW power at 1440 rpm from an electric motor to a machine. Assume peak torque is 20% more than the average torque, design the coupling. Assume following permissible stresses for the components of coupling.

	C.I. (Flange)	Plain carbon steel (shaft & key)	Alloy steel (pin)
Allowable tensile stress (N/mm^2)	20	80	250
Allowable compressive stress (N/mm^2)	60	80	250
Allowable shear stress (N/mm^2)	15	35	125

Take permissible bearing pressure, 1 N/mm^2, assume square key. Assume thickness of brass bush and rubber bush as 2mm and 6mm respectively. **(6)**

2.

A. Why most of the components are designed for infinite life? Write a note on: influence of various factors on the endurance limit of a ductile material. **(4)**

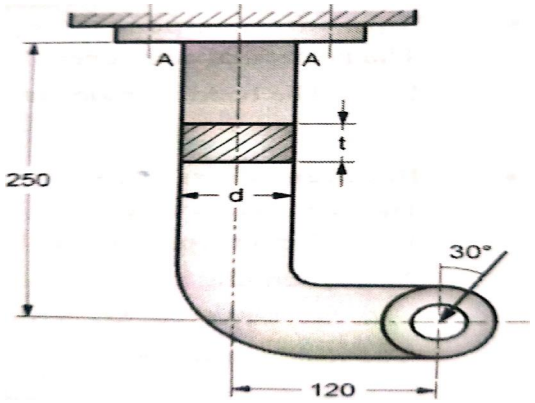
B. Design a closed coiled helical spring, for the valve of an I.C. engine, capable of exerting a net force of 65N when the valve is open and 54N when it is closed. The internal and external diameters are governed by space limitation, as the spring has to fit over a bushing of 20mm outside diameter and go inside a space of 40mm diameter. If the valve lift is 6mm, find the energy stored in the spring. Take spring wire material as oil hardened and tempered plain carbon steel with S_{ut} =

1350 N/mm^2 and modulus of rigidity with 81370 N/mm^2. Also assume spring with square and ground ends and clearance 15% of maximum deflection. **(6)**

3. A foot lever is 1000 mm from centre of shaft to point of application of load of 900 N. Calculate the diameter of shaft, if the permissible shear stress for shaft material is 75 N/mm^2. Determine the dimension of key to secure lever to shaft, safe stress in shear for key material is 70 N/mm^2. Find the dimensions of rectangular arm of the foot lever at 100 mm from centre of shaft. Assume height of lever near boss as 3 times the thickness. Allowable stress is 70 N/mm^2. **(10)**

4.

A. A hanger shown in following figure is subjected to a pull of 10 kN, acting at an angle of 30° to vertical. The bracket has a rectangular section whose depth is two times its thickness. If the permissible tensile stress is 60 N/mm^2, determine the cross-section of the bracket.



All dimensions are in mm **(6)**

B. A shaft is expected to transmit 15 kW at 200 rpm and is supported on two bearings 600 mm apart and two gears are keyed to it. A 14.5° involute, 90mm diameter pinion is located at 120 mm to the right of the right bearing and delivers power to gear directly below the shaft. A 14.5° involute, 360 mm diameter gear is located at 150 mm to the right of the left bearing and receives power from a gear, directly above it. Determine the shaft diameter, if permissible normal stress is 80 MPa. Also, draw corresponding bending moment diagrams.

Also, you can take; On the pinion, vertical load equals to horizontal load times tan(14.5°). Combined shock and fatigue factor for bending and torsion, 1.0 each.

(6)

5.

A. Surface finish factor, size factor, load factor, temperature factor and modifying factor for stress concentration are 0.9, 0.9, 0.92, 1.0 and 1.0 respectively.

A spherical pressure vessel, with 400 mm inner diameter, is welded from steel plates. The welded joints are sufficiently strong and do not weaken the vessel. The plates are made from cold drawn steel 20C8 (S_{ut} = 440 MPa and S_{yt} =240 MPa). The vessel is subjected to internal pressure, which varies from 0 to 5 N/mm^2. The expected reliability is 50% and the factor of safety is 3. If the vessel is expected to withstand infinite number of stress cycles, calculate the thickness of the plates. **(6)**

B. Assuming joint as double riveted butt joint with two cover plates and shearing resistance of rivets in double shear 1.875 times to that of single shear, design the longitudinal riveted joint for a boiler of diameter 2 m taking the permissible pressure as 2.5 MPa. Assume the tensile, shear and compressive stresses for the material of shell and rivets as 90 MPa, 60 MPa, and 120 MPa respectively. You can take the efficiency of longitudinal joint, 70% and corrosion allowance, 3mm. **(6)**