JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE
DEPARTMENT OF MECHANICAL ENGINEERING

COURSE : B.Tech **SEMESTER-V**

SUBJECT : DME-I **CODE:5ME4-04**

ASSIGNMENT-1

1. Explicate the General Considerations in Machine Design.
2. Enumerate the various manufacturing methods of machine parts which a designer should know.
3. Discuss the factors to be considered for the selection of materials for the design of machine elements? Discuss.
4. classify materials for engineering use.
5. Elucidate various types of fit with neat sketch.
6. Portray Hole basis system and Shaft basis system.
7. Explicate the design of casting.
8. Calculate the tolerance and fundamental deviation of sizes for the shaft Designated as 12H8/e8 ($e=-11(D)^{0.41}$).
9. Calculate the tolerances, fundamental deviations and limits of sizes for the shaft designated as 40 H8 / f7.
10. A journal of nominal or basic size of 75 mm runs in a bearing with close running fit. Find the limits of shaft and bearing. What is the maximum and minimum clearance.

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ASSIGNMENT-2

1. Elucidate stress concentration? How can we reduce the effect of stress concentration.
2. Explicate endurance limit and factor affecting the endurance limit.
3. Elucidate factor of safety?
4. Explicate the following terms
(a) Endurance limit, (b) Size factor, (c) Surface finish factor, and (d) Notch sensitivity.
5. Illuminate `stress concentration? How the stress concentration in a component can be reduced.
6. A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4 P. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500MPa, endurance limit of 330 MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9.
7. Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.
8. Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.
Tensile stress = compressive stress = 50 MPa ; shear stress = 35 MPa and crushing stress = 90 MPa.
9. Elucidate soderberg and goodman criteria with neat and clean diagram.
10.Explicate notch sensitivity with example.

ASSIGNMENT-3

1. A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4 P. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9
2. What is a lever ? Explain the principle on which it works.
3. Elucidate the design procedure of a lever for a lever safety valve
4. Design a right angled bell crank lever. The horizontal arm is 500 mm long and a load of 4.5 kN acts vertically downward through a pin in the forked end of this arm. At the end of the 150 mm long arm which is perpendicular to the 500 mm long arm, a force P act at right angles to the axis of 150 mm arm through a pin into a forked end. The lever consists of forged steel material and a pin at the fulcrum. Take the following data for both the pins and lever material:
   Safe stress in tension = 75 MPa
   Safe stress in shear = 60 MPa
   Safe bearing pressure on pins = 10 N/mm2.
5. A lever loaded safety valve is 70 mm in diameter and is to be designed for a boiler to blow-off at pressure of 1 N/mm2 gauge. Design a suitable mild steel lever of rectangular cross-section using the following permissible tresses Tensile stress = 70 MPa; Shear stress = 50 MPa; Bearing pressure intensity = 25 N/mm^2. The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 880 mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 80 mm
6. Demystify full length and graduated leaves of a leaf spring? Write the expression for determining the stress and deflection in full length and graduated leaves.
7. Illustrate nipping in a leaf spring? Discuss its role. List the materials commonly used for the manufacture of the leaf springs .
8. Design a leaf spring for the following specifications :
   Total load = 140 kN ; Number of springs supporting the load = 4 ; Maximum number of leaves = 10; Span of the spring = 1000 mm ; Permissible deflection = 80 mm. Take Young's modulus, E = 200 kN/mm2 and allowable stress in spring material as 600 MPa.
9. locomotive semi-elliptical laminated spring has an overall length of 1 m and sustains a load of 70 kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100 mm width. All the leaves are to be stressed to 400 MPa, when fully loaded. The ratio of the total spring depth to that of width is 2. E = 210 kN/mm2. Determine :
   1. The thickness and width of the leaves.
   2. The initial gap that should be provided between the full length and graduated leaves before the band load is applied.
   3. The load exerted on the band after the spring is assembled.

10. A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3.

ASSIGNMENT -4

1. Classify the keys ? Draw neat sketches of different types of keys and state their applications.

2. Explicate the effect of keyway cut into the shaft?

3. Explicate, with the help of neat sketches, the types of various shaft couplings mentioning the uses of each type.

4. Illustrate flexible couplings and demystify their applications? Illustrate your answer with suitable examples and sketches.

5. Design and make a neat dimensioned sketch of a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.

6. Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3

7. Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. 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 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 14 MPa

8. Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below:
Shear stress on shaft =100 MPa
Bearing or crushing stress on shaft =250 MPa
Shear stress on keys =100 MPa
Bearing stress on keys =250 MPa
Shearing stress on cast iron =200 MPa
Shear stress on bolts =100 MPa

After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. The stresses developed in the various members may be checked if thumb rules are used for fixing the dimensions.
9. Explicate short note on shaft materials.
10.Elucidate Rankine and guest theory for shaft design.

ASSIGNMENT-5

1. Illustrate design of shaft when it is subjected to twisting moment only.

2. Demystify equivalent twisting moment and equivalent bending moment. State when these two terms are used in design of shafts.

3. A solid steel shaft is supported on two bearings 1.8 m apart and rotates at 250 r.p.m. A 20° involute gear D, 300 mm diameter is keyed to the shaft at a distance of 150 mm to the left on the right hand bearing. Two pulleys B and C are located on the shaft at distances of 600 mm and 1350 mm respectively to the right of the left hand bearing. The diameters of the pulleys B and C are 750 mm and 600 mm respectively. 30 kW is supplied to the gear, out of which 18.75 kW is taken off at the pulley C and 11.25 kW from pulley B. The drive from B is vertically downward while from C the drive is downward at an angle of 60° to the horizontal. In both cases the belt tension ratio is 2 and the angle of lap is 180°. The combined fatigue and shock factors for torsion and bending may be taken as 1.5 and 2 respectively. Design a suitable shaft taking working stress to be 42 MPa in shear and 84 MPa in tension.

4. A mild steel shaft transmits 20 kW at 200 r.p.m. It carries a central load of 900 N and is simply
supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads?

5. A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 r.p.m. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure F_{tc} of the gear C and F_{td} of the gear D act Vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively.

6. Explicate the eccentric load action acting parallel to the axis of the bolts.

7. Elucidate the eccentric load action acting perpendicular to the axis of the bolts.

8.Elucidate effect of initial tension due to tightening of bolt

9. Explicate Design process of curved beam

10. Elucidate winker bach formula for curved beam.