SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDHYALAYA
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ENATHUR. KANCHIPURAM – 631 561
DEPARTMENT OF MECHANICAL ENGINEERING

OUESTION BANK

Design of Machine Elements (ME64T054)		
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Class	:	**B.E. (Mechanical Engineering)**
Year / Semester	:	**III Year / VI Semester**

SMALL QUESTIONS

Unit - I

1. State the factors influencing the machine design?
2. What is factor of safety?
3. What are the various theories of failures?
4. Discuss about maximum principal stress theory.
5. Explain about maximum shear stress theory
6. Describe about maximum principal strain theory.
7. Briefly discuss about stress concentration.
8. What are the different failure modes of machine component?
9. What is meant by design stress or working stress?
10. What are steps involved in design process.

Unit - II

1. Define variable load and give some applications.
2. What is fatigue strength?
3. Describe the classification of springs.
4. What is free length of helical spring?
5. Define spring rate and spring index.
6. What is pitch and solid length of spring?
7. What do you mean by endurance limit?

Unit - III

1. Specify the types of shafts.
2. What is the significance of slenderness ratio in shaft design?
3. Define critical speed of shaft.
4. Explain torsional stiffness of the shaft.
5. What is key? Describe the types of keys.
6. What is coupling? Describe the types of couplings
7. What are the stresses induced in shaft?
8. What is the effect of keyway cut into the shaft?
9. Differentiate joint and coupling.
10. What is the difference between axle and spindle?

Unit - IV

1. Define the types of weld joints.
2. What is meant by throat thickness?
3. What is rivet and where is it used?
4. Specify the types of rivets.
5. What is the difference between chain riveting and zig-zag riveting?
6. What is the difference between nominal diameter and gross diameter of rivet?
7. Define efficiency of a riveted joint.
8. What is cotter joint?
9. What is knuckle joint?
10. Give some examples for permanent and temporary joints.
11. Define the terms major diameter, minor diameter, pitch and lead in threaded fasteners.
12. What are the merits and demerits of screw joints?
13. Define thread angle.
14. Give examples of temporary and permanent fasteners.
15. List out the types of butt joint.
16. What are the advantages and disadvantages of threaded joints?
17. Sketch any two types of weld joints.

Unit - V

1. What is jig? Define fixture.
2. State the objectives of jig design.
3. State the types of clamping devices.
4. What are the different types of jigs?
5. Write down the three types of errors that are accounted for jig and fixture design?
6. Differentiate jig and fixture.
7. Explain briefly six point locating principles.

BIG QUESTIONS

Unit - I

1. A vertical pillar at 60mm diameter is su7bjected to a vertical load at 1.1 KN acting eccentrically at a distance at 35mm from the axis. Calculate the maximum stress in the pillar and locate it.

2. A bolts is subjected to an axial force of 10,000N, with a transverse shear force of 5,000N. find the diameter at the bolt required according to:
   - i) Maximum Principal stress theory
   - ii) Maximum Principal strain theory
   - iii) Maximum shear stress theory
   - iv) Maximum distortion energy theory

   Assume permissible tensile stress at elastic limit is 100 N/mm^2 and 1 / m = 0.3

3. A simply supported beam has a concentrated load at the centre which fluctuates from a valve of P to 5P. The span of the beam is 600mm and its cross section is circular with a diameter of 60mm.

4. Taking for the beam material an ultimate stress of 700MPa, a yield stress of 500MPa, endurance limit of 330MPa for reverse bending and a factor of safety is 1.3, calculate the maximum value of P. take a size factor is 0.85 and a surface finish factor is 0.9.

5. A mild steel bracket as shown in figure is subjected to a pull of 5000N acting at 45^o to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross sectional dimension of the bracket, if the permissible stress in the material is limited to 60MPa.

6. An overhang crank with pin and shaft as shown in figure with tangential load of 15KN acts on the crank pin. Determine the maximum principal stress and the maximum shear stress at the centre of the crankshaft bearing.

7. A 20KN tensile load acts on the following members as shown in figure considering stress concentration, calculate the maximum stress induced in each member.

8. A weight 'W' falls on to a collar rigidly attached in the lower end of vertical bar, six meters long and 400mm^2 in cross section. The maximum instantaneous extension is found to be 2mm.Find the value of 'W' and corresponding stress produced in bar.

Unit - II

1. A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 KN and a maximum value of 50 KN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface 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.

2. Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is subjected to a tensile load that has a maximum value of 250 KN and minimum value of 100 KN. The properties of the plate material are as follows: Endurance limit stress = 225 MPa, and yield point stress = 300 MPa . The factor safety based on yield point may be taken as 1.5 and ultimate point is 1.

3. A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 KN/mm^2. Find the axial load which the spring can carry and the deflection per active turn.

4. Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 KN/mm^2.

5. Design a close-coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 Mpa and modulus of rigidity 84 KN/mm^2. Neglect the effect of stress concentration.

6. Design a leaf spring for a truck to the following specifications. Maximum load on the spring = 140KN, number of springs = 4, material of springs is chrome vanadium steel, permissible tensile stress = 600 N/mm^2 Maximum number of leaves = 10, span at spring = 1000mm, permissible deflection = 80mm, young's modulus of the spring = 200KN/mm^2.

7. A leaf spring is subjected to a total load of 140KN. The other parameters of the spring are as follows: number of springs = 4, number of leaves in each spring = 10, allowable stress = 600MPa, span of the spring = 1000mm, deflection allowed = 80mm. Young's modulus of the spring E = 200KN/mm^2. Find the thickness and width of the leaves.

Unit – III

1. A mild steel shaft transmits 20 KW at 200rpm. It carries a central load of 900N and is simply supported between the bearings of 2.4 meters apart. Determine the size of the shaft, if the allowable shear stress is 42MPa & the maximum tensile or compressive stress is not to exceed 56MPa. What size of the shaft will be required, if it is subjected to gradually applied loads.
2. 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 bearings 6m apart and it transmits 5600KW at 150rpm. The maximum axial propeller thrust is 500 KN and the shaft weighs 70KN. Determine the maximum shear stress developed in the shaft and the angular twist between the bearings.
3. A shaft transmits power 2 KW at 150 rpm from the electric motor head stock of lathe by means of a vertical belt drive. The co-efficient of friction for the belt for the belt is 0.3 and the angle of wrap is 180^0. the weight of the pulley is 150N. the shaft material has ultimate stress is 770 N/mm^2 ,yield stress is 560 N/mm^2. Kb = Kt = 1.5. Determine the shaft diameter.
4. Design a bushed – pin flexible coupling for the following data, P = 20KW at 769 rpm. Allowable stresses are as follows in tension 60 N/mm^2,in shear 59 N/mm^2, in crushing 120 N/mm^2 . design torque is 1.5 times of mean torque.
5. Design and draw 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 as 1.35. the following permissible stresses may be used. Permissible shear stress for shaft, bolt and key material is 40 MPa. Permissible crushing stress for bolt and key material is 80 MPa, permissible shear stress for cast iron material is 8 MPa.

6. A belt driven cast iron pulley 120 cm diameter overhangs the nearest bearing by n30 cm. The pulley is driven from below and belt ends are vertical and parallel . the tension on tight side of pulley is 360 N and the ratio of the ratio of tight side tension to slack side tension is 3. if the weight of the pulley is 1000 n, allowable shear stress is 50 N/mm^2, allowable bending stress 80 N/mm^2, Kt = 1.3 and Kb = 1.5.

7. Design and draw a cotter joint to support a load varying from 30KN in compressing to 30KN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.Tensile stress and compressive stress= 50Mpa. Shear stress=35Mpa and crushing stress=90Mpa.

8. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5m in diameter subjected to a steam pressure of $0.95N/mm^2$. Assume joint efficiency as 75%, allowable tensile stress in the plate 90Mpa, compressive stress 140Mpa and shear stress in the rivet 56Mpa.

9. Design a rigid muff coupling and sketch it. A muff made of cast iron is used to connect two steel shafts transmitting 25KW at 300rpm. The material for the shaft and key is plain carbon steel for which allowable shear and crushing stresses are 42 N/mm^2 and 100 N/mm^2 respectively. The allowable shear stress for C.I is $16N/mm^2$.

Unit - IV

1. Design double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5m in diameter subjected to a steam pressure of $0.95KN/m^2$. Assume joint efficiency as 75% allowable tensile stress in the plate 90 N/mm^2, compressive stress 140 N/mm^2 and shear stress in the rivet 56 N/mm^2.

2. Design and draw a cotter joint to support a load varying from 3000N in compression to 3000N 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=500 N/mm^2, shear stress = 350N/mm^2 and crushing stress=900N/mm^2.

3. A plate 100mm wide and 10mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld. The maximum tensile and shear stress are 70 N/mm^2 and 55 N/mm^2 respectively. Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.

4. Design a cotter joint to transmit a load at 120KN in tension or compression. Assume the following permissible stress. Tensile stress = 85 N/mm^2, shear stress = 70 N/mm^2 compressive stress = 165 N/mm^2.

5. Two mild steel rods are connected by a knuckle joint to transmit an axial load of 150KN. Design and draw the joint completely. Assume coefficient of friction is 0.2 and shear stress in pin is 40 X 10^6 N/m^2 .Determine a) diameter of the pin b) input force.

6. An eccentrically loaded lap joint is to be designed for bracket. The bracket plate thickness is 25mm. All rivets are to be of the same diameter. Load on bracket is 50KN. Rivet spacing C = 100mm, eccentrically e = 400mm. Permissible stress is 120MPa. Compute the size of the rivets to be used for the joint.

7. The weld is subjected to a vertical load of 50KN. Determine the fillet size. Allowable shear stress in the weld is 80MPa.

8. Design a knuckle joint to transmit 150KN. The design stresses may be taken as 75MPa in tension, 60MPa in shear and 150MPa in compression.

9. Design a knuckle joint to transmit 55KN. The design stresses may be taken as 60MPa in tension, 45MPa in shear and 100MPa in compression.

10. A 50 mm diameter solid shaft is welded to a flat plate as shown in figure. If the size of weld is 20 mm, find maximum normal and shear stress in the weld.

Unit - V

1. Explain briefly with neat sketch the strap clamp.

2. Explain principle of six point locating.

3. Draw a neat sketch of leaf jig and explain its function.

4. Explain the consideration in design of jigs and fixtures.

5. With the help of a neat sketch explain the flat locator and cylindrical locator.

6. Write down the principles of jig and fixture design.

7. Calculate the clamping force of the screw clamp for 12mm hexagonal headed with 100 mm long spanner and manual pull given to the spanner is 100 N. helix angle is 30^0 and friction angle is 17^0 and pitch radius is 6.6 mm.

8. Draw and explain a suitable fixture for milling of a component as shown in figure.

9. Design a milling fixture for the given component as shown in figure. Depth of cut d = 5mm, width of cut b = 5mm. Feed = 100mm/min, cutting speed = 15m/min. material constant for high carbon steel (k) = 8.5

10. With the help of a neat sketch, explain the screw clamp and edge clamp.