KINGS

COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

Subject code/Name: ME1302 DESIGN OF MACHINE ELEMENTS Year/Sem: III/V

UNIT-I (STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS)

PART-A

1. Define:"Design".
2. What is 'Adaptive design'? Where is it used? Give examples.
3. What are the various phases of design process?
4. List some factors that influence machine design.
5. Explain 'Design for manufacture'.
6. Define:"Optimization".
7. What are the various optimization methods available?
8. Describe material properties hardness, stiffness and resilience.
9. Identify the steel designation as 50 C 4 as per BIS.
10. Determine the composition of the steel designated as 17 Mn 1 Cr 95.
11. What is an impact load? Give examples.
12. Define Principal plane, principal stress.
13. Give some examples of curved beams.
14. State the difference between straight beams and curved beams.
15. Where will be the maximum stress developed in curved beams?
16. Define:"Factor of safety"
17. How is factor of safety defined for brittle and ductile materials?
18. What are the various factors considered in deciding the factor of safety?
19. What are the various factors considered in the selection material for a machine element?
20. Why normal stress theory is not suitable for ductile materials?
21. Define stress concentration and stress concentration factor.
22. State the various methods of finding stress concentration factors.
23. Give some methods of reducing stress concentration.
24. Give one method of reducing stress concentration in key slots.
25. What are the factors that affect notch sensitivity?

26. Explain notch sensitivity. State the relation between stress concentration factor, fatigue stress concentration factor and notch sensitivity.
27. Differentiate between static and variable stresses.
28. What are the types variable stresses?
29. Differentiate between repeated stress and reversed stress.
30. Differentiate between alternating stress and fluctuating stress.
31. Define amplitude stress and stress ratio. What is the ratio of stress ratio for a cyclic stress?
32. What are the various theories of failure?
33. What is the use of Goodman & Soderberg diagrams?
34. Differentiate between Endurance limit and endurance strength.
35. Define endurance limit. What are the various factors affecting endurance strength?
36. Explain size factor in endurance strength.
37. What are the methods used to improve fatigue strength?
38. What is an S-N curve?
39. What is low and high cycle fatigue?

PART-B (STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS)

1. (I) A piston of a reciprocating compressor has a diameter of 60mm.The maximum pressure on the piston fall is 1.25MN/m2.Assuming the gudgeon pin passing through the small end of the connecting rod can be safely loaded in shear up to 10MN/m2, Calculate the minimum diameter of the gudgeon pin. (8)

(ii)Explain with mathematical expressions.

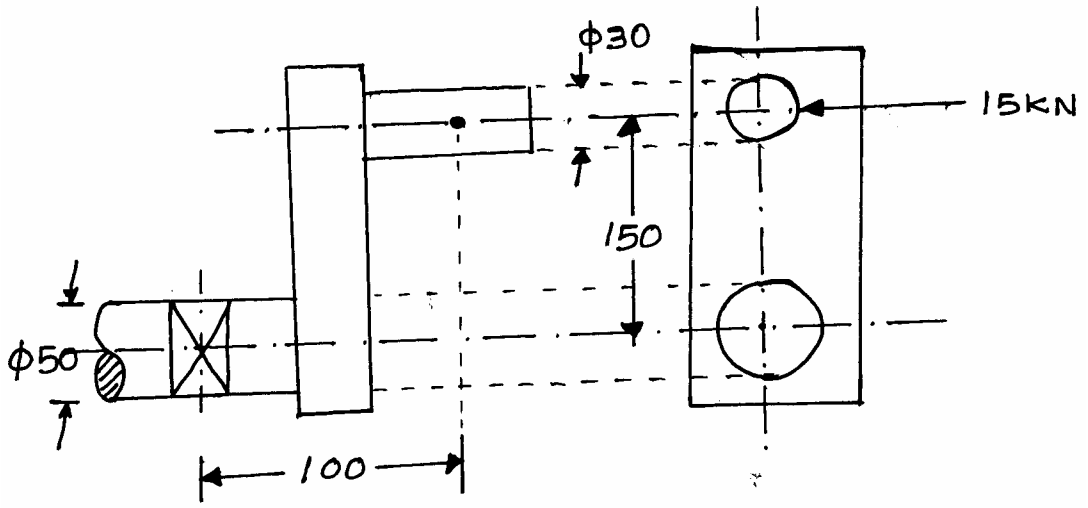
Maximum principal stress theory and Von-Mises-Henky theory (8)

2. (i) Determine the diameter of the steel bar, which is a ductile in a nature subjected to an axial load of 60KN and torsional moment of 1600N-m.Use the factor of safety 2.5.E=200GPa. (8)

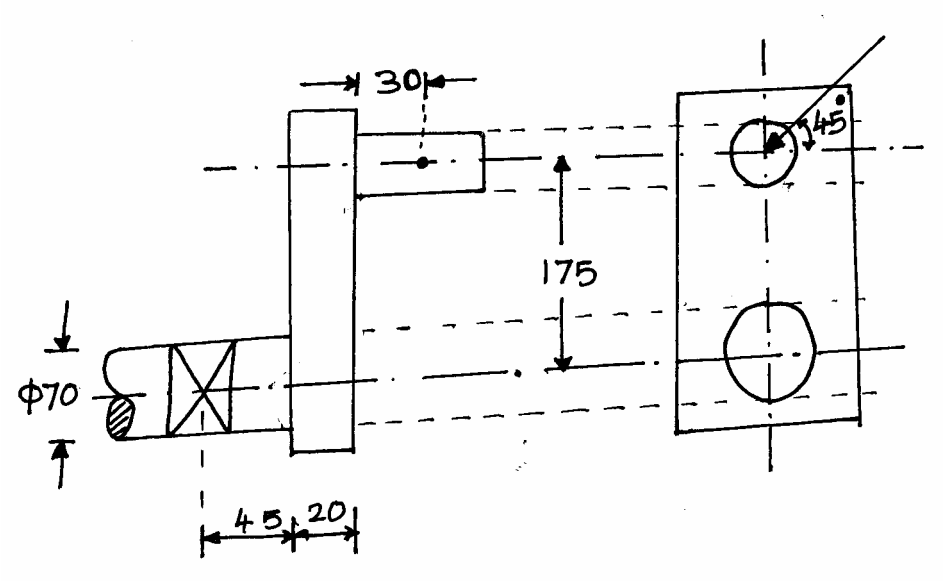
(ii)Explain with mathematical expressions.

Maximum shear theory and Venant's theory (8)

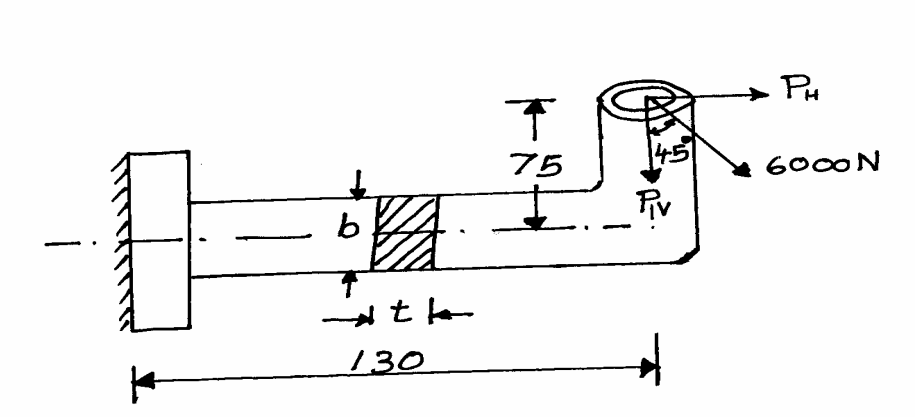
3. A crank shaft bearing is loaded as shown in fig. Determine the maximum principal stress, minimum principal stress and maximum shear stress. (16)



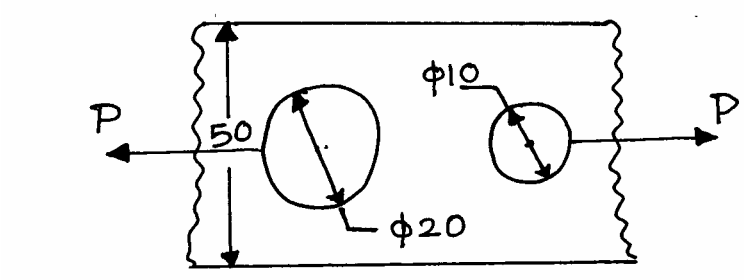
4. Determine the maximum and minimum normal stresses and maximum shear stress at the crank shaft bearing shown in fig. (16)



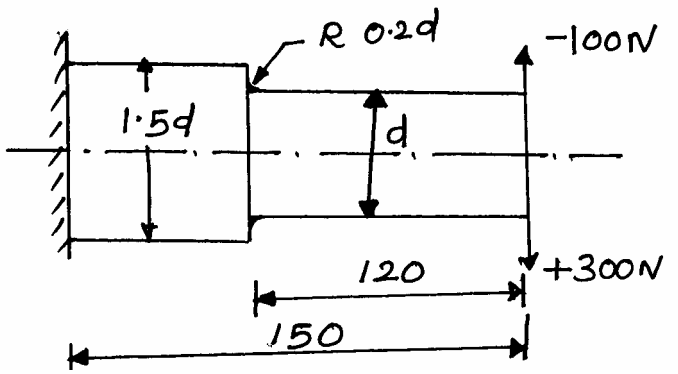
5. A mild steel bracket as shown in fig. is subjected to a pull of 6000N acting at 45° to its horizontal axis. The bracket has a rectangular cross section whose depth is twice the thickness. Find the cross sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60MPa. (16)



6. A steel member is subjected to a 3-D stress system and resulting principal stress are 120N/mm2 tension, 80N/mm^2 and 40N/mm^2 compression. If the proportional limit of the material in simple tension is 280N/mm2 and its poison's ratio is 0.3.Determine the factor of safety according to (a) Maximum principal stress theory (b) Maximum principal strain theory (c) Maximum shear stress theory. (16)
7. A bolt is subjected to a tensile load of 25KN and a shear load of 10KN.Determine the diameter of the bolt according to (a) Maximum principal stress theory (b) Maximum principal strain theory (c) Maximum shear stress theory. Assume factor of safety 2.5, Yield point stress in simple tension 300N/mm^2, Poisson's ratio is 0.25. (16)
7. Taking stress concentration in to account find the maximum stress induced when a tensile load of 20KN is applied to (i) A rectangular plate 80mm wide and 12mm thick with a transverse hole of 16mm diameter.(ii)A stepped shaft of diameters 60mm and 30mm width a fillet radius of 6mm. (16)
8. A plate 12mm thick with two holes as indicated in fig. is subjected to tensile load of 20KN. Calculate the stresses at both holes. (16)



9. A cantilever rod of circular cross section is subjected is subjected to a cyclic transverse load varying from -100N to +300N as shown in fig. Determine the diameter 'd'of the rod by
   (i) Goodman method (ii) Soderberg method using following data
   Factor of safety = 2
   Theoretical stress concentration factor = 1.4
   Notch sensitivity factor = 0.9
   Ultimate strength = 550Mpa
   Yield strength = 320MPa (16)



10. A circular bar is simply supported with a span of 0.5mand is subjected to a concentrated cyclic load at its midspan.The load varies from a minimum value of 20KN to maximum value of 45KN.The load direction is transverse to the shaft axis. Decide upon the diameter of the bar taking a factor of safety of 1.5 and factor of 0.85 and 0.89 respectively for size effect and surface finish. Take often following values for material properties.
    Ultimate strength = 650N/mm^2
    Yield strength = 450N/mm^2
    Endurance strength =350N/mm2 (16)
11. The bending stress in a machine part fluctuates between a tensile stress of 280N/mm2 and a compressive stress of 140N/mm^2.What should be the minimum ultimate tensile strength of this part to carry this fluctuation indefinitely according to (i) Goodman's formula (ii) Soderberg formula Factor of safety is 1.75.Assume that the yield point is never likely to be less than 55% of the ultimate tensile strength or greater than 93% of it. (16)

12. Determine the thickness of a 120mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of 1000N.The properties of the plate materials are as follows. Endurance limit stress is 225MPa and yield point stress is 300MPa. The factor of safety based on yield point may be taken as 1.5. (16)
13. A hot rolled bar of steel is subjected to a torsional load varying from-150N-m to 450N-m. Determine the required diameter of the bar using a factor of safety of 1.7.Properties of the material may be assumed as follow.
    Ultimate tensile stress = 450MPa
    Yield stress = 300MPa (16)
14. A transmission of shaft made C45 steel subjected to a fluctuating torque varying from -100N-m to +500N-m.Also a fluctuating bending moment acts on the shaft which varies from +500N-m to -500N-m.Let the stress concentration factor be 2.The shaft is machined for a factor of safety of 1.5.Determine the required diameter of the shaft. (16)

UNIT-II (DESIGN OF SHAFTS, KEYS AND COUPLINGS)

PART-A

1. What is shaft?
2. What are the types of shafts?
3. List all the shaft materials.
4. What is simple torsion?
5. What is simple bending moment?
6. Write down the formula for finding equivalent twisting moment.
7. What are types of rigidity?
8. What are different measures followed to control the lateral deflection?
9. What are the different ways to limit the maximum permissible transverse deflection?
10. Define the term critical speed.
11. Write down the dunkerley's equation for the critical speed of the shaft.
12. What is key?
13. What are types of keys?
14. How are sunk keys designed?
15. What is the main use of woodruff keys?

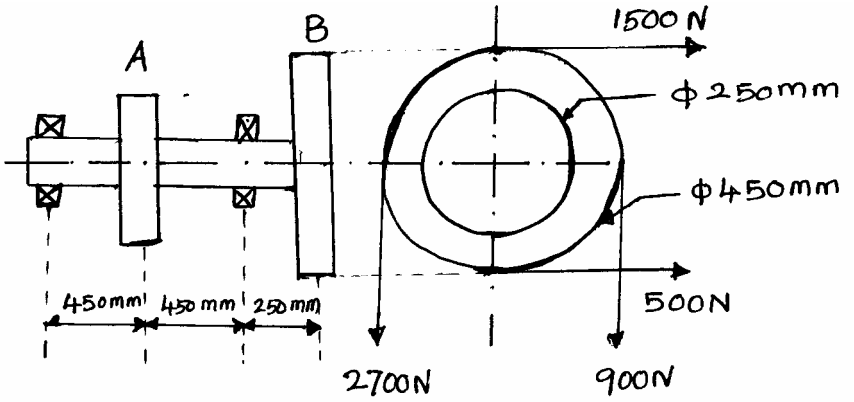
16. List various failures occurred in sunk keys.
17. Differentiate between keys and spines.
18. What is the function of a coupling between two shafts?
19. Under what circumstances flexible couplings are used?
20. Where are flexible couplings used?
21. How is a couplings specified?
22. What are the purposes in machinery for which couplings are used?
23. Name any two of the rigid and flexible couplings?
24. What is material used for flange or flange couplings?
25. What is the advantage of Gear coupling?
26. Differentiate between a cotter joint and a knuckle joint.

UNIT-II (DESIGN OF SHAFTS, KEYS AND COUPLINGS)

PART-B

1. A line shaft rotating at 200rpm is to transmit 20KW power. the allowable shear stress for the shaft material is 42N/mm^2.If the shaft carries a central load of 900N and is simply supported between bearing 3meters apart determine the diameter of the shaft. The maximum tensile or compressive stress is not to exceed 56N/mm^2. (16)
2. An electric generator rotates at 200rpm and receives 300KW from the driving engine. The armature of the generator is 60cm long and located between bearing 120cm center to center. Owing to the combined weight of armature and magnetic pull, the shaft is subjected to 9000kg acting at right angles to the shaft. The ultimate stress for the shaft is 4480kg/cm^2 and shear stress is 3920kg/cm^2.Find the diameter of the shaft for a factor of safety of 6. (16)
3. A mild steel shaft transmit 23KW to 200rpm.It carries a central load of 900N and is simply supported between the bearing 2.5meters apart. Determine the size of the shaft, if the allowable shear stress is 42MPa and the maximum tensile or compressive stress is not exceed 56MPA.What size of the shaft will be required, if it is subjected to gradually applied load? (16)
4. A shaft to transmit 50KW at 1200rpm.It is also subjected to a bending moment of 275N-m.Allowable shear stress is 60N/mm^2.The shaft is not to twist more than 2° in a length of 2m.G=80X10^{3}N/mm^2.Design a shaft. (16)
5. A factory line shaft is 4.5m long and is to transmit 75KW at 200rpm.The allowable stress in shear is 49MPa and maximum allowable twist is 1° in a length of 20mm diameter. Determine the required shaft diameter. (16)

6. A solid shaft is to transmit 1000KW at 120rpm.Find the shaft diameter if the design shear stress is 80N/mm^2.If the shaft is made hollow with internal diameter is 0.6 times the outside diameter, find the percentage of saving material. (16)
7. A solid shaft to transmit power from an electric motor to a machine through a pulley by means of a vertical belt drive with unit speed ratio. The pulley weights 250N and is overhanging at a distance of 120mm from the bearing. Diameter of the pulley is 200mm.Maximum power transmitted at 150rpm is 3KW.Coefficient of friction between the belt and the pulley is 0.25.Combined shock and fatigue factor in torsion is 1.5 and in bending is 2.0,permissible shear stress for the shaft material is 40N/mm^2.Design the shaft.Standared diameter from R20 series in mm are:20,22.4,25,28,31.5,40,45,50,56,63,71&80. (16)
8. A line shaft supporting two pulleys A and B is shown in fig. Power is supplied to the shaft by means of vertical belt on pulley A, Which is then transmitted to pulley B carrying a horizontal belt. The ratio of the belt tensions on tight and loose side is 3:1 and the maximum tension in either belt is limited to 2.7KN.The shaft is made of plain carbon steel 40C8 (S_{ut}=650N/mm^2 and S_{yt}=380N/mm^2).The pulleys are keyed to the shaft. Determine the shaft diameter according to the A.S.M.E code if K_b=1.5 and K_t=1.0. (16)



9. (a)Determine the dimensions of the rectangular sunk key made up of mild steel for a 80mm diameter mild steel shaft to transmit to torque of 135N-m.
   Assume τ =50N/mm^2 and σ_c=120N/mm^2. (8)
   (b)Design a taper key for a shaft of diameter 100mm transmitting 60KW at 300rpm.
   The allowable compressive stress may be taken as 175N/mm^2. (8)

10. Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90KW at 250rpm.The allowable shear stress in the shaft is 40MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolt is 30MPa. (16)
11. Design a cast iron protective type flange coupling to transmit 15KW at 900rpm from an electric motor to a compressor. The service factor may be assumed as 1.35.
    The following permissible stress may be used:
    Shear stress for the shaft, bolt and key material=40MPa
    Crushing stress for bolt and key=80Mpa
    Shear stress for cast iron=8Mpa (16)
12. A rigid type coupling is used to connect two shaft transmit 15KW at 200rpm.The shaft, key and bolts are made of C45 steel and the coupling is of C.I.Design the coupling. (16)
13. Design and sketch protective type C.I flange coupling to transmit 10KW at 250rpm. The permissible shear stress for key, shaft, bolt as 50N/mm2.Take crushing stress of key as 90N/mm^2 and shear stress for C.I as 14N/mm^2.Assume maximum torque is 30% higher than mean torque. (16)

UNIT-III (DESIGN OF FASTNERS AND WELDED JOINTS)

PART-A

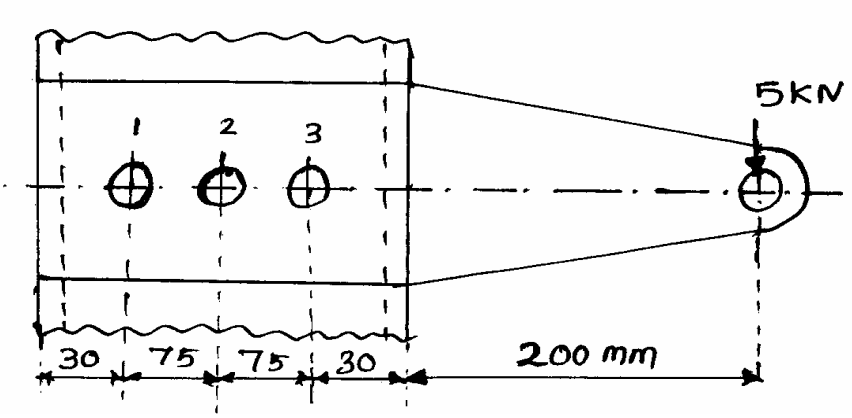
1. What are the purposes of screws?
2. Define: Pitch, Lead.
3. List some types of commonly used thread forms.
4. How is a bolt designated?
5. State the advantages of coarse thread.
6. State the advantages of threaded joints.
7. What are differential and compound screws?
8. What are the advantages of preloading?
9. What factors influence the amount of initial tension?
10. What is bolt of uniform strength?
11. What are the ways to produce bolts of uniform strength?
12. What stresses act on screw fastening?
13. Define the term self locking of power screws.
14. Define welding.

15. Why are welded joints preferred over riveted joints?
16. How is welding classified?
17. How is forged welding performed?
18. State something about electric resistance welding.
19. State the main principle of fusion welding.
20. What are the general applications of welding?
21. What are the advantages of welding?
22. What are the limitations of welding?
23. What are the types of welded joints?
24. Define butt and lap joint.
25. Define T-joint and corner joint.
26. Define edge joint.
27. State the types of forces involved while designing.
28. State the welded symbols for double U-joint and single V-joint.
29. When will the edge preparation need?
30. Write down the formula for tensile strength of a double V-groove butt joint.
31. What are the two types of fillet weld?
32. Write down the formula for strength of fillet and double fillet.
33. Write down the formula for the strength of single transverse fillet weld.
34. Differentiate with a neat sketch the fillet weld subjected to parallel loading and transverse loading.
35. Write down the formula for the strength of the combination of single traverse and fillet welds.
36. Define eccentrically loaded welded joints.
37. When will the weld deposit be weaker?
38. What are the two types of eccentric welded connections?
39. State the two types of eccentric welded connections.
40. Write down the formula for maximum shear stress according to maximum stress theory.
41. What is the concentration factor? Where does it occur?
42. What are the significances of welding specifications?

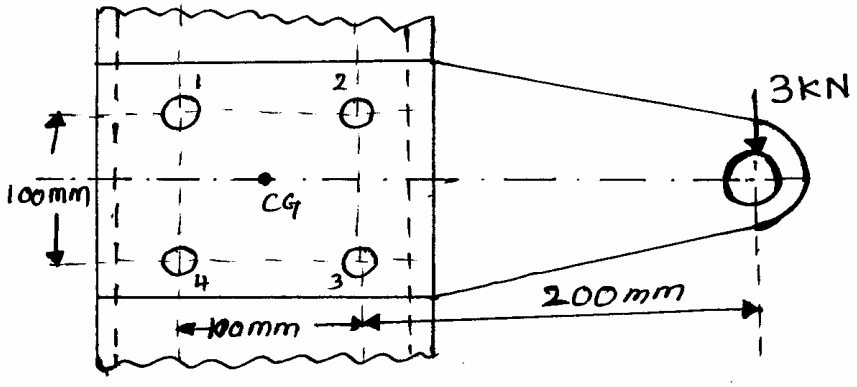
UNIT-III (DESIGN OF FASTNERS AND WELDED JOINTS)

PART-B

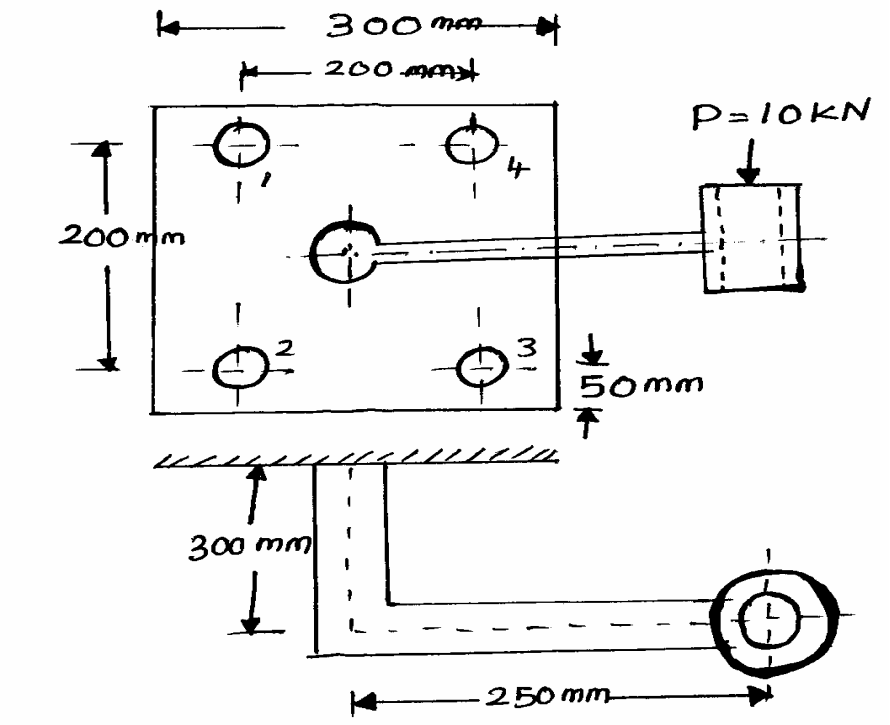
1. The cylinder head of a steam engine with 250mm bore is fastened by eight stud bolts made of 30C8 steel. Maximum pressure inside the cylinder is 1MPa.Determine the bolt size and approximate tightening torque. Take 20% over load. Assume σ_y=300MPa. (16)
2. A steam of effective diameter 300mm is subjected to a steam pressure of 1.5N/mm2.The cylinder head is connected by 8 bolts having yield point 330MPa and endurance limit at 240MPa.The bolts are tightened with an initial per load 1.5 times the steam load. A soft copper gasket is used to make the joint leak proof. Assuming a factor of safety2, find engine size of bolt required. The stiffness factor for copper gasket may be taken as 0.5. (16)
3. A steam engine cylinder has an effective diameter of 350mm and the maximum steam pressure acting on the cylinder cover is 1.25N/mm^2.calculate the number and the size of studs are required to fix the cylinder cover. Assume the permissible stress in the stud 70N/mm^2. (16)
4. Find the suitable bolt for the application shown in fig. (16)



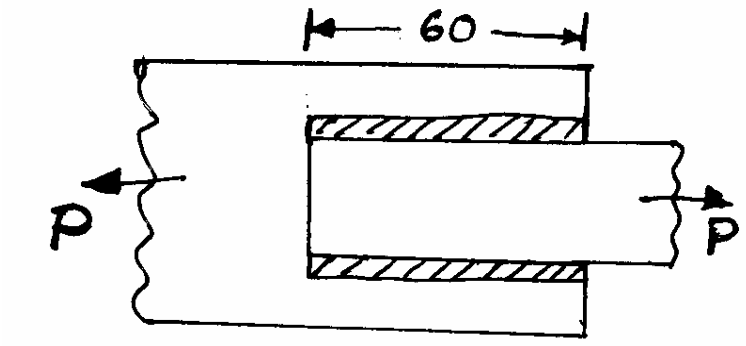
5. A steel plate subjected to a force 3KN and fixed to a vertical channel by means of four identical bolts is shown in fig. The bolts are made of plain carbon steel 45C8 (S_{yt}=380N/mm^2) and the factor of safety is 2.Determine the nominal diameter of the bolt. (16)



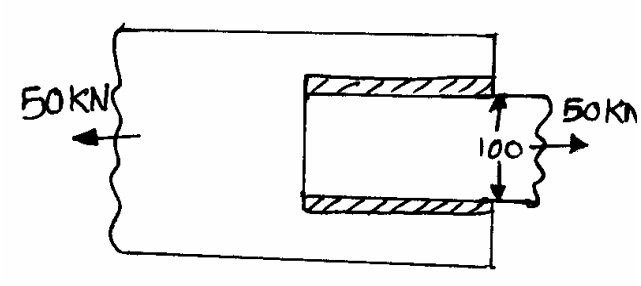
6. A rigid steel bracket subjected to a vertical force of 10KN is shown in fig. It is fastened to a vertical sanction by means of four identical bolts. Determine the size of the bolts by maximum shear stress theory. The maximum permissible shear stress in any bolts is limited to 50N/mm^2. (16)



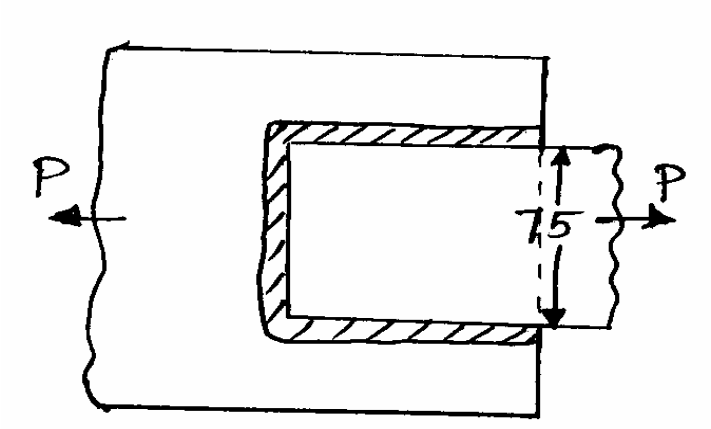
7. A plate 60mm and 10mm thick is weld to another plate by two parallel fillet welds as shown in fig. Determine the shaft load that the weld joint can carry. The allowable working stress in shear for the weld material is 75N/mm^2. (16)



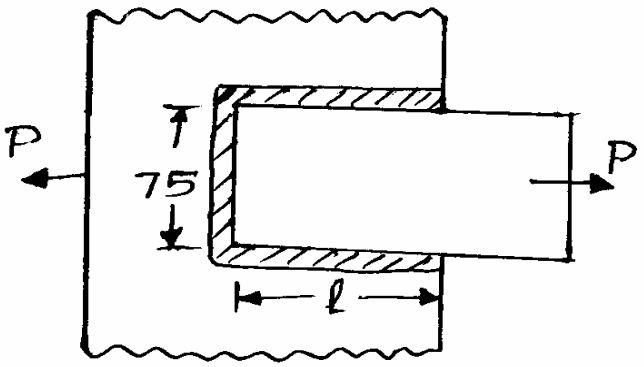
8. A plate 100m wide and 12.5mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50KN.Find the length of the weld so that the maximum stress does not exceed 56N/mm2. (Do the calculations under static loading). (16)



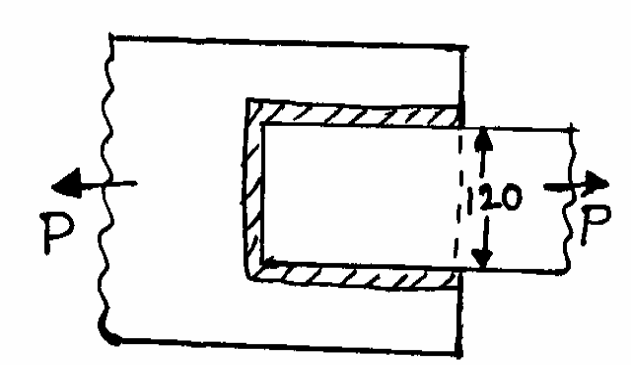
9. A plate 75mm wide and 12.5mm thick is jointed with another plate by a single transverse weld and double parallel fillet as shown in fig. The maximum tensile and shear stress are 70MPa and 56MPa respectively. Find the length of each parallel fillet weld if the joint is subjected to static and fatigue loading. (16)



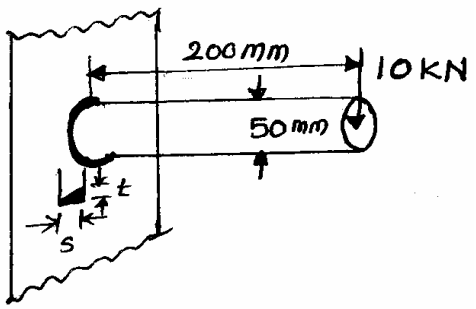
10. A plate 75mm wide and 10mm thick is jointed with another plate by a single transverse weld and double parallel fillet as shown in fig. The joint is subjected to a maximum tensile force of 55KN.The permissible tensile and shear stress are 70MPa and 50MPa respectively. Find the length of each parallel fillet weld. (16)



11. Determine the length of the weld run for a plate of size 120mm wide and 15mm thick to be welded to another plate by means of (1) A single transverse weld (2) Double parallel fillet welds when the joint is subjected to variable loads. Assume σ =70MPa, τ =56MPa. (16)

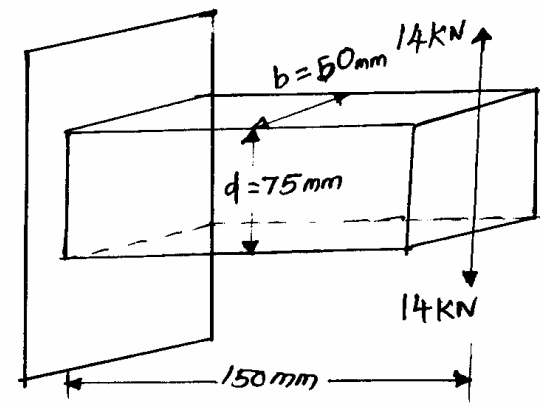


12. (i)A 50mm diameter solid shaft is welded to a flat plate in fig. If the size of the weld is 15mm.Find the maximum normal shear stress in the weld. (8)



(ii) A circular bar of 50mm diameter and 200mm long is welded to a steel plate. It support a vertical download 10KN at it free end. Determine the weld size assuming strength of the weld to be 94MPa. (8)

13. A rectangular beam is to be welded to a plate. The maximum plate of 14KN is applied respectively. Determine the size of the required for 10,000,000cycles.Assume shear load is distributed uniformly over the entire weld. (16)



UNIT-IV (DESIGN OF SPRINGS AND LEVERS)
PART-A

1. What is a spring?
2. What are the applications of springs?
3. State any two functions of springs.
4. What are the various types of springs?
5. Classify the helical spring.
6. How will you find whether the given helical spring is a compression spring os tension spring?
7. Define: Leaf springs.
8. Define: Belleville springs.
9. What are conical springs?
10. What is spring index? Or Define the term spring rate.
11. What are active coils?
12. What are inactive coils?
13. What is pitch?
14. What is solid length?
15. What are the requirements of spring while designing?
16. Write down the formula for shear stress of a helical spring.
17. Write down the formula for shear stress correction factor.
18. What is shear stress correction factor according to the Wahl's hypothesis?
19. Write down the formula for deflection of a helical spring.
20. What is stiffness of spring?
21. Define: Energy stored in springs.
22. What are the end conditions of spring?
23. What are the disadvantages of springs?
24. What is buckling of springs?
25. What is surge in springs?
26. Write down the formula for natural frequency of spring.
27. What is meant by springs in series?
28. What is meant by springs in parallel?
29. When two concentric springs of stiffness 100N/mm and 50N/mm respectively are subjected to an axial load of 750N, what will be the deflection of each spring?
30. For springs in series, the spring rates (stiffness) add reciprocally.-Prove.

31. Define surging of springs.
32. What are the various spring materials?
33. What are the different groups according to service conditions?
34. How concentric springs are obtained?
35. State the spring index for concentric springs.
36. State the advantages of Leaf spring over the helical spring.
37. Write down the formula for bending stress and deflection.
38. Write down the formula for maximum stress and deflection of cantilever spring and simply supported spring.
39. What is laminated leaf spring?
40. What are semi-elliptical leaf springs?
41. What is nipping of laminated leaf spring? Discuss its role in spring design.
42. Why wahl's factor is to be considered in the design of helical compression springs?
43. Mention any four basic terms involved while designing levers.
44. Give the section modulus for the following sections.
45. Write down the formula of section modulus for circular hollow section.
46. What are the factors to be considered for designing fulcrum pin of the lever?
47. What are the uses of foot levers?
48. What are the uses of hand levers?

UNIT-IV (DESIGN OF SPRINGS AND LEVERS)
PART-B

1. A helical valve spring is to be designed for an operating load range of 90N to 135N.The deflection of the spring for this load range is 7.5mm.Assuming a spring index of 10, a permissible shear stress of 480N/mm^2 and a modulus of rigidity of 0.8X10^5 N/mm^{2}for the material, determine the dimensions of the spring. (16)

2. A gas engine valve spring is to have a mean diameter 37.5mm.The maximum load will have to sustain is 450N with a corresponding deflection of 12.5mm.The spring is to be subjected to repeated loading and fatigue must be considered a low working stress of 300N/mm^2 will be used. Find the size for the wire and number of coil used. Take rigidity of modulus as 0.8X10^5 N/mm^2. (16)

3. A compressive helical spring is required to exert a minimum force 250N and maximum force of 600N and the deflection for this change in load to be 15mm.The spring must fit in a hole of 30mm diameter. The load is static. Ultimate tensile stress is 1393N/mm^2 and shear stress is 606Mpa. (16)

4. A closely coil helical spring is made of 10mm diameter steel wire, the coil consisting of 10 complete turns with a mean diameter of 120mm.The springs carries an axial pull of 200N.Determine also deflection in the spring, its stiffness and strain energy stored by it if the modulus of rigidity of the material is 80KN/mm^2. (16)

5. A helical compression of spring made of oil tempered carbon steel ,is subjected to a load which varies from 4ooN to 1000N.The spring index is 6 and the design factor of safety is 1.25.If the yield stress in shear is 770Mpa ,and endurance stree in shear is 350Mpa,find,(1)Size of the spring wire (2)Diameter of the spring wire (3)Number of turns of the spring (4)Free length of the spring. The compression of the spring at the maximum load is 30mm.The modulus of rigidity for the spring material may be taken as 80KN/mm^2. (16)

6. A semi-elliptical leaf spring of 1m long and is required to resist a load of 50KN.The spring has 15 leaves of which three are full length leaves. The width of central band is 100mm.All the leaves are to be stressed to 420MPa.The ratio of total depth to width is 3.Take, E=2.1X10^{5}MPa.Determine, (i) The thickness and width of the leaves.
(ii)The initial gap that should be provided between the full lengths and graduated leaves before assembly.
(iii)The load exerted on the band for the assembly. (16)

7. A leaf spring for a small trailer is to support a load of 8KN.The spring has 8 graduated leaves and 2 free full length leaves of spring steel of safe stress 380MPa.The over all length 1m and the central band is 80mm wide. Taking ratio of total total depth of leaves as 3.Design the spring and also determine the deflection of the spring. Take, E=2.1X10^{5}MPa. (16)

8. Design of leaf spring for a truck to the following specifications:
   Maximum load on the spring = 140KN
   No of spring = 4
   Material for spring chromium vanadium steel
   Permissible tensile stress = 600N/mm^2
   Maximum number of leaves =10
   Span of spring = 1000mm
   Permissible deflection = 80mm
   Young's modulus of the spring = 200N/mm^2 (16)

9. Design a cantilever leaf spring to absorb 600N-m energy without exceeding a deflection of 150mm and a stress of 800N/mm^2.The length of the spring is 600mm.The material of the spring is steel.Take,E=200KN/mm^2. (16)

UNIT-V (DESIGN OF BEARING AND FLYWHEELS)
PART-A

1. What is the nature of contact involved in a ball bearing element?
2. Define antifriction bearing.
3. What are the types of rolling contact bearings?
4. What are the several types of radial ball bearings?
5. What are the types of thrust ball bearings?
6. Classify the roller bearing.
7. What is load rating?
8. Explain the term dynamic load carrying capacities of rolling contact bearing.
9. State any points to be considered for selection of bearings.
10. Classify the types of bearing?
11. List any six types of bearing materials.
12. What is a journal bearing?
13. What is known as self-acting bearing?
14. What are the terminologies is used in designing of journal bearing?
15. What is bearing characteristic number?

16. How Summerfield number calculated?
17. Write down the formula to calculate the heat generated and heat dissipated in journal bearings.
18. What is critical pressure?
19. What is flywheel?
20. What is the function of fly wheel?
21. What are the applications of flywheel?
22. State any two types of flywheel.
23. What is flywheel effect?
24. Define coefficient of fluctuation of speed in case of flywheels.
25. Define the term "fluctuation of energy".
26. State the types of stresses induced in a rim flywheel.
27. What are the stresses induced in flywheel arms?
28. Write down the formula for the maximum torque that can be transmitted by the flywheel of solid and hollow shaft.
29. How does the function of flywheel differ from that of governor?

UNIT-V (DESIGN OF BEARING AND FLYWHEELS)

PART-B

1. Design a journal bearing for a centrifugal pump with the following data:
   Diameter of the journal = 150mm
   Load on bearing = 40KN
   Speed of journal = 900rpm (16)

2. Design a journal bearing for a centrifugal pump from the following data:
   Load on the journal=20000N, Speed of the journal=900rpm, Type of oil isSAE10,for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.5°C, Maximum bearing pressure for the pump=1.5N/mm^2.Calculate also mass of the lubricating oil required for artificial cooling, If the rise of temperature, if the rise of temperature of oil be limited to 10°C heat dissipation coefficient=1232W/m^2/°C (16)

3. A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of 1.4N/mm^2. The speed of the journal is 900rpm and the ratio of journal diameter to the diametral clearance is 1000.The bearing is lubricated with oil, whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011kg/m-s.The room temperature is 3°5C.Find,
   (1) The amount of artificial cooling required.
   (2)The mass of lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C.Take, specific heat of oil as 1850J/Kg/°C. (16)

4. A 150mm diameter shaft supporting a load of 10KN has a speed of 1500rpm.The shaft run in whose bearing length is 1.5 times the shaft diameter. If the diametral clearance of bearing is 0.15mm and the absolute viscosity of the oil at the operating temperature is 0.011Kg/m-s. Find the power wasted in friction. (16)

5. A 80mm long journal bearing support a load of 2800N on a 50mm diameter shaft. The bearing has a radial clearance of 0.05mm and the viscosity of the oil is 0.021 Kg/m-s at the operating temperature. If the bearing is capable of dissipating 80J/s.determine the maximum safe speed. (16)

6. Determine the maximum tensile stress in the thin rim of a steel flywheel rotating at 600rpm. The mean radius of rim is 1500mm.The fly wheel rim is 200mm thick and 300mm wide. The area of cross section of the rim is 0.06m2 and each of the six spokes is constant in cross section area of 0.01m2.Find also stress in each spoke. (16)

7. A single cylinder double acting steam delivers 185KW at 100rpm.The maximum fluctuation of energy per revolution is 15percent of the energy developed per revolution. The speed variation is limited to 1percent either way from the mean. The mean diameter of the rim is 2.4m.Design and draws two views of the flywheel. (16)

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