SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR

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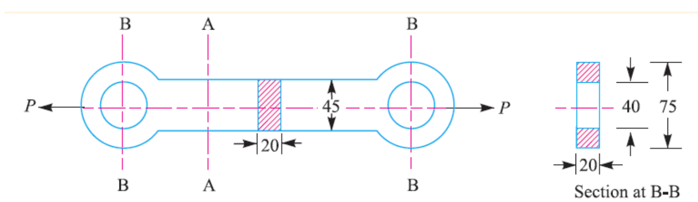
QUESTION BANK (Descriptive)

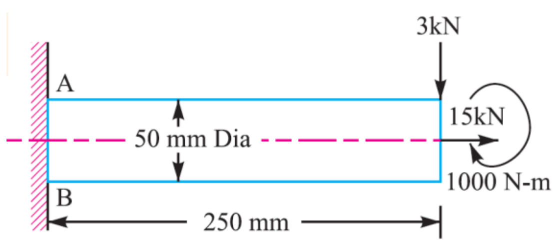
Subject with Code :DMM-I (**16ME314**)	**Course & Branch**: B.Tech - ME
Year & Sem: III-B.Tech& I-Sem	**Regulation:** R16

UNIT-I

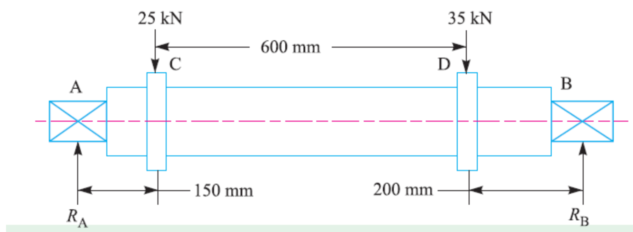
1	a	How do you classify materials for engineering use?	6M
	b	Draw the stress –strain diagram for mild steel. Explain.	6M
2	a	How do you classify the machine design? Explain	6M
	b	Explain the general design procedure while designing a machine element	6M
3	a	What are the general design consideration should be followed while designing a machine element	6M
	b	What are the manufacturing consideration should be followed while designing a machine element	6M
4	a	What do you mean by preferred numbers and explain the applications?	6M
	b	What is meant by factor of safety? Explain how it can be used in design applications.	6M
5	a	A cast iron link, as shown in Fig., is required to transmit a steady tensile load of 45 kN. Find the tensile stress induced in the link material at sections A-A and B-B.	6M



	b	A hydraulic press exerts a total load of 3.5 MN. This load is carried by two steel rods, supporting the upper head of the press. If the safe stress is 85 MPa and E = 210 kN/mm2, Find: 1. diameter of the rods, and 2. extension in each rod in a length of 2.5m.	6M
6		A shaft, as shown in Figure, is subjected to a bending load of 3 kN, pure torque of 1000 N-m and an axial pulling force of 15 kN. Calculate the stresses at A and B.	12M



7	a	Derive an expression for the impact stress induced due to a falling load	6M
	b	An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 kN/mm^2.	6M
8		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, find the maximum value of this torque without causing yielding of the shaft according to 1. the maximum principal stress; 2. The maximum shear stress; and 3. the maximum distortion strain energy theory of yielding.	12M
9	a	Write the bending stress relation and draw the diagram.	5M
	b	A pump lever rocking shaft is shown in Fig. The pump lever exerts forces of 25 kN and 35 kN concentrated at 150 mm and 200 mm from the left and right hand bearing respectively. Find the diameter of the central portion of the shaft, if the stress is not to exceed 100 MPa	7M

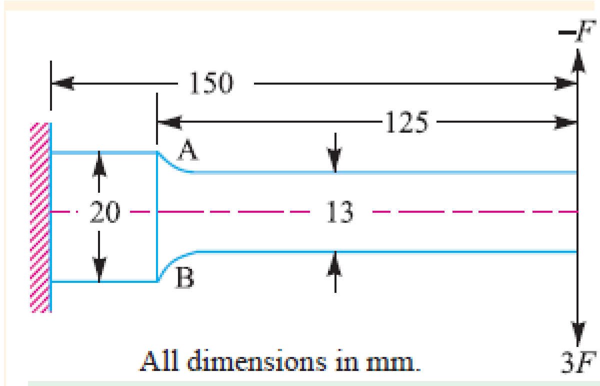


10		The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal strain theory; 4. Maximum strain energy theory; and 5. Maximum distortion energy theory.	12M

UNIT-II

1		Explain Goodman's and Soderberg's and Gerber's parabola equation for combination stresses.	12M
2		Explain stress concentration in detail and various methods to reduce stress concentration in machine members	12M
3		A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 MPa and the yield strength is 400 MPa. The bending moment at the pulley varies from – 150 N-m to +400 N-m as the torque on the shaft varies from –50 N-m to +150 N-m. Obtain the diameter of the shaft for an indefinite life. The stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values: Factor of safety = 1.5. Load correction factors = 1.0 in bending and 0.6 in torsion. Size effect factor = 0.85. Surface effect factor = 0.88	12M

4		A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N.m clockwise to 110 N. mcounter clockwise and an applied bending moment at a critical section varies from 440N-m to-220 N-m. The shaft is of uniform cross-section and no key way is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and yield strength of 410 MN/m^2.Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and surface finish factor of 0.62.	12M
5	a	Discuss the factors affecting endurance limit	5M
	b	Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete reversal), σ_e=265 MPa and tensile yield strength of 350 MPa. The member is subjected to a varying axial load from W_{min} =-300 KN to W_{max} = 700 KN and has a stress concentration factor is 1.8. Use factor of safety as 2.	7M
6	a	Explain the following terms (i)Theoretical stress concentration factor, (ii) fatigue stress concentration factor, (iii) Notch sensitivity.	6M
	b	A machine component is subjected to a fluctuating stress that varies from 40 N/mm^2 to 100 N/mm^2. The corrected endurance limit of the machine component is 270 N/mm^2. The ultimate stress and yield point stress of the material are 600 and 400 N/mm^2 respectively. Find the factor of safety using: (i) Gerber formula. (ii) Solderberg line. (iii) Goodman line.	6M
7		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 finish factor of 0.9. The material properties of bars are given by: ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.	12M
8		Cantilever beam made of cold drawn carbon steel of circular cross-section as shown in Fig. Is subjected to a load which varies from – F to 3 F. Determine the maximum load that this member can withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42 and the notch sensitivity is 0.9. Assume the following values : Ultimate stress = 550 MPa; Yield stress = 470 MPa; Endurance limit = 275 MPa Size factor = 0.85 ; Surface finish factor= 0.89	12M



9 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. 12M

10 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. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. 12M

Take yield strength = 0.55 Ultimate strength;

Endurance strength = 0.5 Ultimate strength; and

factor of safety = 2.

UNIT-III

1 Find the efficiency of the following riveted joints : 12M

1. Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm.
2. Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm.

Assume Permissible tensile stress in plate = 120 MPa ; Permissible shearing stress in rivets = 90 MPa ; Permissible crushing stress in rivets = 180 MPa

2 a What is the difference between caulking and fullering? Explain with the help of neat sketches 6M

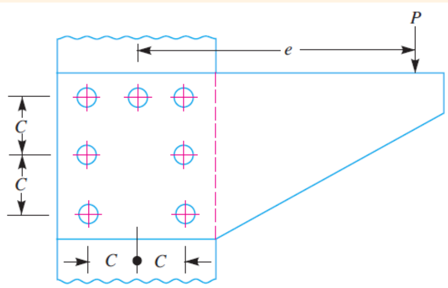
b A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch which will rupture the joint. If the above joint is subjected to a load such that the factor of safety is 4, Find out the actual stresses developed in the plates and the rivets. 6M

3 A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. 12M

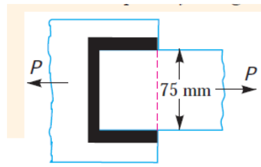
Assume $\sigma_t = 80$ MPa ; $\tau = 60$ MPa ; and $\sigma_c = 120$ MPa

State how the joint will fail and find the efficiency of the joint

4	a	Explain briefly the method of riveting	6M
	b	Double riveted double cover butt joint in plates 20 mm thick is made with25 mm diameter rivets at 100 mm pitch. The permissible stresses are :$\sigma_t = 120$ MPa; $\tau = 100$ MPa; $\sigma_c = 150$ MPa Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear.	6M
5		An eccentrically loaded lap riveted joint is to be designed for a steel bracket as shown in Fig. The bracket plate is 25 mm thick. All rivets are to be of the same size. Load on the bracket, P = 50 kN ; rivet spacing, C = 100 mm; load arm, e = 400 mm. Permissible shear stress is 65 MPa and crushing stress is 120 MPa. Determine the size of the rivets to be used for the joint.	12M

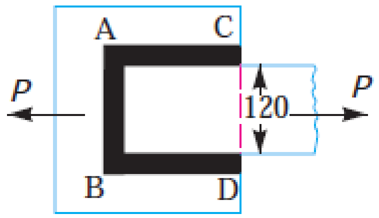


6	a	Write advantages and disadvantages of welded joint over riveted joints	6M
	b	Discuss the standard location of elements of a welding symbol.	6M
7	a	What are the assumptions made in the design of welded joint?	6M
	b	Sketch and discuss the various types of welded joints used in pressure vessels. What are the considerations involved?	6M
8	a	What is an eccentric loaded welded joint? Discuss the procedure for designing such a joint	6M
	b	A plate 100 mm wide and 10 mm thick is to be welded to another plate by means of double parallel fillets. The plates are subjected to a static load of 80 kN. Find the length of weld if the permissible shear stress in the weld does not exceed 55 MPa.	6M
9		A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.	12M



10 Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of 12M

1. A single transverse weld; and
2. Double parallel fillet welds when the joint is subjected to variable loads.



UNIT-IV

1 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. 12M

2 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 : 12M

σ_t= 60 MPa ; τ = 70 MPa ; and σ_c = 125 MPa.

3 Design a gib and cotter joint to carry a maximum load of 35 kN. Assuming that the gib, cotter and rod are of same material and have the following allowable stresses : 12M

σ_t = 20 MPa ; τ = 15 MPa ; and σ_c = 50 MPa.

4 Design a knuckle joint to transmit 150 kN. The design stresses may be taken as75 MPa in tension, 60 MPa in shear and 150 MPa in compression. 12M

5 a What are the applications of a cotter joint? 5M

b Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6. 7M

6 a What types of stresses are induced in shafts? 5M

b A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10 000 N-m. The shaft is made of 45 C 8 steel having ultimate tensile stress of 700 MPa and a ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter 7M of the shaft.

7 A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is180° and μ = 0.24. Determine the suitable diameter for a solid shaft, allowing working stress of63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.. 12M

8 A steel solid shaft transmitting 15 kW at 200 r.p.m. is supported on two bearings750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. 12M

9 a How the shaft is designed when it is subjected to twisting moment only ? 6M

b A shaft made of mild steel is required to transmit 100 kW at 300 r.p.m. The supported length of the shaft is 3 meters. It carries two pulleys each weighing 1500 N supported at a distance of 1metre from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft. 6M

10 a A solid shaft is transmitting 1 MW at 240 r.p.m. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa. 6M

b A steel spindle transmits 4 kW at 800 r.p.m. The angular deflection should not exceed 0.25° per meter of the spindle. If the modulus of rigidity for the material of the spindle is 84GPa, find the diameter of the spindle and the shear stress induced in the spindle. 6M

UNIT-V

1 a What is a key? State its function with neat sketch. 6M

b A 45 mm diameter shaft is made of steel with yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2 6M

2 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 12M

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.

3 Design and draw 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. 12M

4 Design a cast iron protective type flange coupling to transmit 15 kW at 900r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used : 12M

Shear stress for shaft, bolt and key material = 40 MPa;

Crushing stress for bolt and key = 80 MPa; Shear stress for cast iron = 8 MPa

Draw a neat sketch of the coupling.

5 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. 12M

6 Design and draw a cast iron flange coupling for a mild steel shaft transmitting90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. 12M

7 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: 12M

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.

8 Two 35 mm shafts are connected by a flanged coupling. The flanges are fitted with 6 bolts on 125 mm bolt circle. The shafts transmit a torque of 800 N-m at 350 r.p.m. For the safe 12M

stresses mentioned below, calculate 1. Diameter of bolts; 2. Thickness of flanges; 3. Key dimensions; 4. Hub length; and 5. Power transmitted.

Safe shear stress for shaft material = 63 MPa; Safe stress for bolt material = 56 MPa

Safe stress for cast iron coupling = 10 MPa ; Safe stress for key material = 46 MPa

9 The shaft and the flange of a marine engine are to be designed for flange coupling, in which the flange is forged on the end of the shaft. The following particulars are to be considered in the design : 12M

Power of the engine = 3 MW; Speed of the engine = 100 r.p.m.

Permissible shear stress in bolts and shaft = 60 MPa ; Number of bolts used = 8

Pitch circle diameter of bolts = 1.6 × Diameter of shaft

Find: 1. diameter of shaft; 2. diameter of bolts; 3. thickness of flange; and 4. diameter of flange.

10 Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. 12M

The material properties are as follows :

(a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.

(b) The allowable shear stress for cast iron is 15 MPa.

(c) The allowable bearing pressure for rubber bush is 0.8 N/mm^2.

(d) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling.