ASSIGNMENT QUESTIONS

UNIT I

LONG ANSWERS

1. a) What are the general considerations in the design of machine elements?

   b) A cast iron pulley transmits 10 KW at 400 rpm. The diameter of the pulleys 1.2 meter and it has four straight arms of elliptical cross section. In which the major axis is twice the minor axis. Determine the dimensions of the arm if the allowable bending stress is 15MPa.

   C) Explain simple stresses

2. a) Explain Goodman failure .

   b) A circular bar of 0.5 m 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 factor of 0.85, surface finish factor of 0.9. The material properties of bar is given by : Ultimate strength of 650 MPa, Yield strength of 500 MPa and Endurance strength of 350 MPa.

   c) Draw S-N curve for mild steel and explain its significance.

   b) Explain briefly the various theory of failures.

1. a) Explain the modified Goodman diagram for bending stresses.

   b) A transmission shaft of cold drawn steel 27Mn2 (S_{ut} = 500 N/mm^2 and, S_{yt} = 30N/mm^2) is subjected to a fluctuating torque which varies from -100 N-m to +400 N-m. The factor of safety is 2 and the expected reliability is 0%. Neglecting the effect of stress concentration, determine the diameter of the shaft. Assume the distortion energy theory of failure.

2. a) What are the manufacturing considerations in the design of Castings?

   b) A manufacturer is interested to start his business with five different models of tractors ranging from 7.5 to 75 KW capacities. Specify power capacities of models. There is an expansion plan to further increase the number of models from five to nine to fulfill the requirements of the farmers. Specify the power capacities of additional models.

3. a) Explain briefly about Soderberg and Goodman lines with neat sketches.

   b) 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 bar are given by : Ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.

UNIT II

4. a) Explain briefly about the preferred numbers.
b) A cantilever cold drawn steel bar 20 mm diameter and 100 mm length is loaded by a transverse force of 0.55 kN, an axial load of 8 kN and a torque of 30 Nm. The yield tensile and compressive strength are 165 MPa and 190MPa.Compute factor of safety based on Maximum shear stress theory and Maximum distortion energy theory.

5. a) Draw the Gerber curve, Goodman and Soderberg lines with neat sketch and explain its significance.
b) A solid circular shaft made of steel Fe620 (S_{ut} = 620 N/mm^2 and S_{yt} = 380 N/mm^2) is subjected to an alternating torsional moment, that varies from -200N-m to +400 N-m. The shaft is ground and the expected reliability is 90%. Neglecting the stress concentration, Calculate the shaft diameter for infinite life. The factor of safety is 2.Use the distortion energy theory of failure.

6. a) Explain briefly about the torsional and bending stresses in the design of machine elements.
b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10kN-m and a torsional moment of 30kN-m. Determine the diameter of shaft using all theories of failure and assuming a factor of safety of 2. Take E = 210 GPa and Poisson's ratio = 0.25.

7. a) Estimate the factors that affect the fatigue strength.
b) A simply supported beam has a point load at the centre which fluctuates from a value F to 4F. Length of beam is 500 mm and cross section is circular with a diameter of 60 mm. Ultimate, yield stresses are 700 MPa and 500 MPa respectively. Endurance limit in reverse bending is 330 MPa. Factor of safety desired is 1.3.Assume size factor 0.83, Surface finish factor 0.9, reliability factor 1.0.Find the maximum value of F.

8. a) Explain the manufacturing considerations in design.
b) State and explain various theories of failure under static loading.
c) Find the diameter of shaft required to transmit 60 kW at 150 rpm if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible torsional shear stress of 60 N/mm^2. Also find the angle of twist for a length of 2.5 meters. Take G = 80 GPa.

9. a) Explain the types of fluctuating stresses.
b) A hot rolled steel shaft is subjected to a torsional moment that varies from +350 Nm to -115 Nm and an applied bending moment at a critical section varies from 445 Nm to 225 Nm. The shaft is of uniform cross section. Determine the required shaft diameter. The material has an ultimate strength of 550 MPa and yield strength of 410 MPa. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. (Using Goodman's Line).

10. a) What is the difference between caulking and fullering? Explain with the help of neat sketches.
b) Design a triple riveted longitudinal double strap butt joint with unequal straps for a boiler. The inside diameter of the drum is 1.3 meters. The joint is to be designed for a

steam pressure of 2.4 N/mm^2. The working stresses to be used are σ_t=77N/mm^2, τ=62 N/mm^2; σc=120 N/mm^2. Assume the efficiency of the joint as 81 %.

11. Find the diameter of shaft required to transmit 60 kW at 150 rpm if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible torsional shear stress of 60 N/mm^2. Also find the angle of twist for a length of 2.5 meters. Take G = 80 GPa.

12. a) Explain the causes of stress concentration.
b) A circular cross section cantilever beam having length 130 mm. subjected to a cyclic transverse load of varying form -150 N to 350 N, FOS is 2, theoretical stress concentration factor is 1.4, notch sensitivity factor is 0.9, ultimate strength is 540 MPa, yield strength is 320 MPa. Size correction factor is 0.85. Endurance limit is 275 MPa, surface correction factor is 0.9 and notch sensitivity factor is 0.9. Determine the diameter of the beam by (i) Goodman method and (ii) Soderberg method.

13. a) Discuss various theories of failure.
b) Find the diameter of shaft required to transmit 60 kW at 150 rpm if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible torsional shear stress of 60 N/mm^2. Also find the angle of twist for a length of 2.5 meters. Take G = 80 GPa.

14. a)) Explain the factors that affect the fatigue strength.
b) A machine member is made of plain carbon steel of ultimate strength 650 N/mm^2 and endurance limit of 300 N/mm^2. The member is subjected to a fluctuating torsional moment which varies from -200 Nm to 400 Nm. Design the member using (i) modified Goodman's equation and (ii) Soderberg equation.

15. a) A shaft is required to transmit 1 MW power at 240 rpm. The shaft must not twist more than 1° on a length of 15 diameters. If the modulus of rigidity for material of the shaft is 80 GPa, find the diameter of the shaft and shear stress induced.

b) A bolt is subjected to a direct tensile load of 20 kN and a shear load of 15 kN. Suggest the suitable size of bolt according to various theories of elastic feature, if the yield stress in simple tension is 360 MPa. A factor of safety of 3.5 should be used. Take Poisson's ratio as 0.25.

16. a) Explain the factors that affect the fatigue strength.

b) A machine member is made of plain carbon steel of ultimate strength 650 N/mm^2 and endurance limit of 300 N/mm^2. If the member is subjected to a fluctuating torsional moment which varies from -200 N-m to 400 N-m. Design the member using (i) modified Goodman's equation and (ii) Soderberg equation.

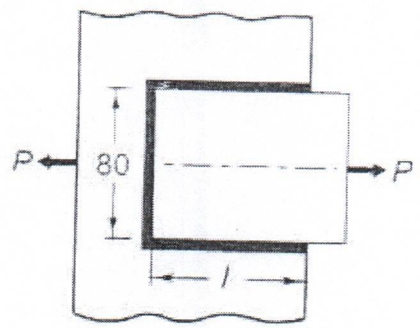
UNIT III

LONG ANSWERS

1. **a)** Explain briefly the design considerations of welded assemblies.

   b) How the strength of transverse fillet weld is evaluated?

   c) A steel plate, 80 mm wide and 10 mm thick, is joined to another steel plate by means of a single transverse and double parallel fillet weld, as shown below Fig. 1. The strength of the welded joint should be equal to the strength of the plate to be joined. The permissible tensile and shear stresses for the weld material and the plates are 100 MPa and 70 MPa respectively. Find the length of each parallel fillet weld. Assume that the tensile force passes through the centre of gravity of three welds.



2. a) Explain the design procedure for the eccentrically loaded bolted joint.

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

3. a) Explain briefly the design of welded joints subjected to twisting moment and the bending moment.

   b) A circular shaft, 75 mm in diameter, is welded to the support by means of a circumferential fillet weld. It is subjected to a torsional moment of 3000 N-m. Determine the size of the weld, if the maximum shear stress in the weld is not to exceed 70 N/mm^2.

4. a) What are the advantages and disadvantages of welded joints?

   b) A 65 mm diameter solid shaft is to be welded to a flat plate by a fillet weld around the circumference of the shaft. Determine the size of the weld if the torque on the shaft is 3 kNm and the allowable shear stress in the weld is 70 MPa.

5. a) A bolt is subjected to a direct tensile load of 20 kN and a shear load of 15 kN Suggest the suitable size of bolt according to various theories of elastic failure, if the

yield stress in simple tension is 360 MPa. A factor of safety of 3.5 should be used. Take Poisson's ratio as 0.25.

6. a) Explain the bolts of uniform strength.

   b) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 N/mm^2. The cylinder head is connected by 8 bolts having yield point 330 N/mm^2 and endurance limit at 240 N/mm^2. The bolts are tightened with an initial preload of 1.5 times the steam load. Assume a factor of safety 2. Find the size of bolt required the stiffness factor for copper gasket may be taken as 0.5.

7. a) Explain with sketches the different types of failures and efficiencies of the riveted joints.

   b) Two MS tie bars for a bridge structure are to be joined by means of a butt joint with double straps. The thickness of the tie bar is 12 mm and carries a load of 400 kN. Design the joint completely taking allowable stresses as 100 MPa in tension, 70 MPa in shear and 150 MPa in compression.

8. a) Discuss the advantages and disadvantages of riveted, bolted and welded joints.

   b) Design a cotter joint of socket and spigot type which is subjected to a pull and push of 50 kN. All the parts of the joint are made of the same material with the permissible stress as 70 MPa in tension, 100 MPa in compression and 40 MPa in shear.

9. a) Explain briefly design procedure for circumference lap joint for a boiler.

   b) Design a triple riveted longitudinal butt joint with unequal cover plates for a boiler seam. The diameter of the boiler is 2 m and the internal pressure is 2 MPa. The working stresses are 70 MPa in tension, 50 MPa in shear and 120 MPa in compression and the required efficiency of the joint is 80%.

UNIT IV

LONG ANSWERS

1. a) Briefly explain the procedure to design a shaft based on any two theories of failures.

   b) It is required to design a knuckle joint to connect circular shafts subjected to an axial force of 50 kN. The rods are coaxial and a small amount of angular movement between their axes is permissible. Design the joint and specify the dimensions of its components. The allowable tensile, compressive and shear stress in the rod and pin material is limited to 80MPa, 100MPa and 40MPa respectively.

2. a) Explain types of couplings.
   b) A mild steel shaft has to transmit 70 kW at 240 rpm. The allowable shear stress in the shaft material is limited to 45MPa. Design a cast iron flange coupling. The shear stress in the coupling bolt is limited to 30MPa.

3. a) A shaft, 40 mm in diameter is transmitting 35 KW power at 300 rpm by means of Kennedy keys of 10X10 mm cross section. The keys are made of steel 45C8 ($S_{yt} = S_{yc} = 380\ N/mm^2$) and the factor of safety is 3.Determine the required length of the keys.
   b) 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. $\sigma_t = 60$ MPa , $\tau = 70$ MPa and $\sigma_c = 125$ MPa.

4. a) Explain the design procedure for flexible coupling.
   b) Design a Cast Iron flange coupling for a steel shaft transmitting 15 KW at 200 rpm 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.

5. a) Explain briefly about the design of shafts subjected to combined bending and torsion.
   b) A line shaft is to transmit 30 KW at 160 rpm. It is driven by a motor placed directly under it by means of a belt running on a 1m diameter pulley keyed to the end of the shaft. The tension in the tight side of the belt is 2.5 times that of the slack side and the centre of pulley overhangs 150 mm beyond the centre line of the end bearing. Determine the diameter of the shaft, if the allowable shear stress is 56MPa and the pulley weighs 1600 N.

6. a) Explain about the design of Bushed pin flexible coupling with a neat sketch.
   b) Design a Cast Iron flange coupling for a mild steel shaft transmitting 90 KW at 250 rpm. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1^0 in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa.

7. a) Explain the design procedure for Muff Coupling.
   b) Design a Cast Iron flange coupling for a mild steel shaft transmitting 90 KW at 250 rpm. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1^0 in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa.

8. a) Write the design procedure for a flexible coupling
   b) Design a Muff coupling which is used to connect two steel shafts transmitting 40 KW at 350 rpm. The material for the shaft and key is plain carbon steel for which allowable shear and crushing stresses may be taken as

40MPa and 80MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15MPa.

9. a) Compare weight, strength and stiffness of two shafts of same material, subjected to same torque. One being solid other being hollow with inner diameter to outer diameter ratio 0.5.
b) Two shafts are connected by means of a flange coupling to transmit torque of 25 Nm. The two flanges of the coupling are fastened by four bolts of the same material at a radius of 30mm. Find the size of the bolts if the allowable shear stress for the bolt material is 30MPa.

10. Design and a cast iron coupling for a mild steel shaft transmitting 90kW at 250 rpm. The allowable shear stress in the shaft is 40MPa and the angle of twist is not to exceed 1^0 in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30MPa.

11. Design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5. The design torque is 1.5times of rated torque. Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of the components.

12. Design a bushed pin type flexible coupling for connecting a motor shaft to a pump shaft for the following service conditions. Power to be transmitted = 40 kW, speed of the motor shaft = 1000 rpm. The material properties are : i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively, ii) allowable shear stress for cast iron is 15 MPa, iii) Allowable bearing pressure for rubber brush is 0.8 N/mm^2 and iv) the material of the pin is same as that of shaft and key. Draw neat sketch of the coupling.

UNIT V

LONG ANSWERS

1. a) Explain the design procedure for the socket and spigot joint.
   b) A circular steel bar 50 mm diameter and 200 mm long is welded perpendicularly to a steel plate to form a cantilever to be loaded with 5KN at the free end. Determine the size of the weld, assuming the allowable stress in the weld is 100 MPa.

2. a) 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.
   b) Explain briefly a design of shafts subjected to combined bending and torsion.

3. a) Write the design procedure for Jib and Cotter joint for square rods.
   b) A mild steel shaft transmits 20 KW at 200 rpm. It carries a central load of 900 N and is simply supported between the bearings 2.5 m 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?

4. a) Explain different types of keys.
   b) Design a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55N/mm^2 in tension, 40N/mm^2 in shear and 70 N/mm^2 in crushing. Draw a neat sketch of the joint.

5. a) Explain stresses acting on keys.
   b) Design a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55N/mm^2 in tension, 40N/mm^2 in shear and 70 N/mm^2 in crushing. Draw a neat sketch of the joint.

6. Two tie rods are to be connected by means of a sleeve and two steel cotters. The rods are subjected to a tensile load of 40kN. Design the joint using the permissible stress in tension as 60MPa, in shear as 50MPa and in crushing as 120MPa. Draw a neat sketch and show all the dimensions.

RISE Krishna Sai Prakasam Group of Institutions

Valluru, ONGOLE - 523 272, Prakasam Dist., A.P.

I MID Examination Date..........

Name: CH venkata Krishna Course: B.Tech Branch .... Year & Sem ....

H.T. No. 178A1A0313 ... MPD

Name of the Invigilator .... Signature of the Invigilator ....

Total No.of Addl. Sheets .... Total Marks : 15 / 15

Answers

15/15

(A) given $P_{t1} = 10 kN$, $P_s = 5 kN$, $\sigma_t = 100 MPa = 100 N/mm^2$; $1/m = 0.3$

Diameter of the bolt (d) = (d)

Area of the bolt $(A) = \frac{\pi}{4} d^2 = 0.7854 d^2 mm^2$

axial tensile stress $\sigma_1 = \frac{P_{t1}}{A} = \frac{10}{0.7854 d^2} = \frac{12.73}{d^2} kN/mm^2$

transfer shear stress $(\tau) = \frac{P_s}{A}$

$= \frac{5}{0.7854 d^2} = \frac{6.365}{d^2} kN/mm^2$

(a) : Principal stress:-

$\sigma_{t1} = \frac{\sigma_1 + \sigma_2}{2} + \frac{1}{2} + \frac{1}{2}\left[\sqrt{(\sigma_1 - \sigma_2)^2 + 4\tau^2}\right]$

$= \frac{12.73}{2d^2} + \frac{1}{2}\left[\sqrt{\left(\frac{12.73}{d^2}\right)^2 + 4\left(\frac{6.365}{d^2}\right)^2}\right]$

$= \frac{6.365}{d^2} + \frac{1}{2} \times \frac{6.365}{d^2}\left[\sqrt{4+4}\right]$

$\sigma_{t1} = \frac{15.365}{d^2} N/mm^2$

Scanned by CamScanner

(bii) maximum shear stress:

$$\tau_{max} = \frac{1}{2}\left[\sqrt{(\sigma_1-\sigma_2)^2+4\tau^2}\right] = \frac{1}{2}\left[\sqrt{(\sigma_1)^2+4\tau^2}\right]$$

$\sigma_2 = 0$

$$= \frac{1}{2}\left[\sqrt{\left[\frac{12.73}{d^2}\right]^2+4\left[\frac{6.365}{d^2}\right]^2}\right] = \frac{1}{2}\times\frac{6.365}{d^2}\left[\sqrt{4+4}\right]$$

$$= \frac{9}{d^2}\ kN/mm^2 = \frac{9000}{d^2} = N/mm^2$$

$$\tau_{max} = \frac{\sigma_t(el)}{2}(or) = \frac{9000}{d^2} = \frac{100}{2} = 50.$$

$$d^2 = \frac{9000}{50} = 180 \text{ or } d = 13.42\ mm.$$

(c) maximum principle straine theory:—

$$\sigma_{t_1} = \frac{\sigma_1}{2} + \frac{1}{2}\left[\sqrt{(\sigma_1)^2+4\tau^2}\right] = \frac{15365}{d^2}$$

minimum principle stress.

$$\sigma_{t_2} = \frac{\sigma_{t_1}}{2} + \frac{1}{2}\left[\sqrt{(\sigma_1)^2+4\tau^2}\right]$$

$$= \frac{12.73}{2d^2} - \frac{1}{2}\left[\sqrt{\left[\frac{12.73}{d^2}\right]^2+4\left[\frac{6.365}{d^2}\right]^2}\right]$$

$$= \frac{6.365}{d^2}\left[1-\sqrt{2}\right] = \frac{-2.635}{d^2}\ kN/mm^2$$

$$= \frac{-2635}{d^2}\ N/mm^2$$

⟹ according to maximum principle straine theory.

$$\frac{\sigma_{t_1}}{E} - \frac{\sigma_{t_2}}{mE} = \frac{\sigma_t(el)}{E} \text{ or } \sigma_{t_1} - \frac{\sigma_{t_2}}{m} = \sigma_t(el)$$

$$\frac{15365}{d^2} + \frac{2635 \times 0.3}{d^2} = 100$$

$$d^2 = \frac{16156}{100} = 161.56 \text{ (or) } d = 12.7 \text{ mm.}$$

⇒ (d) maximum straine energy theorem.

$$(\sigma_{t_1})^2 + (\sigma_{t_2})^2 - \frac{2\sigma_{t_1} \times \sigma_{t_2}}{m} = [\sigma_{t(el)}]^2$$

$$\left[\frac{15365}{d^2}\right]^2 + \left[\frac{-2635}{d^2}\right]^2 - 2 \times \frac{15365}{d^2} \times \frac{-2635}{d^2} \times 0.3 = (100)^2$$

$$\frac{23600}{d^4} + \frac{694}{d^4} + \frac{2430}{d^4} = 1$$

$$d^4 = 26724.$$

$$d = \sqrt{(\sqrt{26724})}$$

$$d = 12.78 \text{ mm.}$$

(E) maximum distortion energy theory

$$(\sigma_{t_1})^2 + (\sigma_{t_2})^2 - 2\sigma_{t_1} \times \sigma_{t_2} = [\sigma_{t(el)}]^2$$

$$\frac{236 \times 10^6}{d^4} + \frac{6.94 \times 10^6}{d^4} + \frac{80.97 \times 10^6}{d^4} = 10 \times 10^3.$$

$$\frac{23600}{d^4} + \frac{694}{d^4} + \frac{8097}{d^4} = 1.$$

$$d^4 = 32391$$

$$d = \sqrt{(\sqrt{32391})}$$

$$d = 13.4 \text{ mm.}$$

(2A) Given:- $w_{max} = 180$ K.N

$w_{min} = -180$ K.N

$F.S = 2$

$\sigma_u = 1010$ MPa $= 1010$ N/mm²

$\sigma_y = 910$ MPa $= 910$ N/mm²

$\sigma_e = 0.5\sigma_u$; $K_a = 0.7$; $K_{sur} = 0.8$, $K_{sz} = 0.85$.

$K_f = 1$

diameter of the rod (d) = d

Area $A = \frac{\pi}{4} d^2 = 0.7854 d^2$ mm²

average load:-

$$w_m = \frac{w_{max} + w_{min}}{2} = \frac{180 + (-180)}{2} = 0.$$

mean stress $(\sigma_m) = \frac{w_m}{A} = 0$.

variable load: $w_v = \frac{w_{max} - w_{min}}{2}$

$$= \frac{180-(-180)}{2} = 180 \text{ K.N} = 180 \times 10^3 N.$$

variable stress $(\sigma_v) = \frac{w_v}{A} = \frac{180\times10^3}{0.7854 d^2} = \frac{229\times10^3}{d^2}$ N/mm²

Endurance limit in reversed axial loading: $\sigma_{ea} = \sigma_e \times K_a = 0.5\sigma_u \times 0.7 = 0.35\sigma_u$

$= 0.35 \times 1010 = 374.5$ N/mm²

=> Soderberg's formula for reversed axial

$$= \frac{1}{F.S} = \frac{\sigma_m}{\sigma_y} + \frac{\sigma_v \times K_f}{\sigma_{ea} \times K_{sur} \times K_{sz}}$$

$$= \frac{1}{2} = 0 + \frac{229\times10^3 \times 1}{d^2 \times 374.5 \times 0.8 \times 0.85} = \frac{900}{d^2}$$

$d^2 = 900 \times 2 = 1800$

$d = 42.4$ mm

RISE Krishna Sai Prakasam Group of Institutions
Valluru, ONGOLE - 523 272, Prakasam Dist., A.P.
I Mid / lab Exam Additional Answer Sheet
H.T.No. .... Date .... Additional Sheet No. 1
Name of the Subject / Lab .... Signature of the Invigilator ....

(3A) The Advatages and disadvantages of welded joints over rivited joints.

Advatages:-

1. The welded structures are usually lighter than rivited structure.
(2) The welded joints provide maximum effi[illegible] which is not possible in case of rivited joints.
(3) Alternations and additions can be easily mad in the existing structures.
(4) As the welded connection structure is smooth in appearence therefore it looks pleasing.
(5) In welded joints has a great strength over the rivited joints.
(6) In welded connections the tension members are not weakened in the case to rivited joints.
(7) The process of welding takes less time than the riveting.

⇒ Disadvantages

(1) Since there is an uneven heating and cooling during fabrication, therefore the member may get distorted or additional stresses may develop.

(2) It requires a highly skilled labour and supervision.

(3) Since no provision is kept for expansion and contraction in the frame, therefore there is a possibility of cracks developing in it.

(4) The inspection of welding work is more difficult than riveting work.

Scanned by CamScanner

RISE Krishna Sai Prakasam Group of Institutions

Valluru, ONGOLE - 523 272, Prakasam Dist., A.P.

....II.... MID Lab Examination Date.........

Name ..... D. Kumar ..... Course ..... B.Tech. Branch Mech.. Year & Sem II & II

H.T. No. ..... 178A1A0315 ..... Lab .....

Name of the Invigilator ..... Signature of the Invigilator .....

Total No. of Addl. Sheets ..... 01 ..... Total Marks ..... 15 / 15

15/15

(1)

A.

Given that

$p = 35\text{ KN} = 35000\text{N}$

$\sigma_t = 80\text{MPa} = 80\text{ N/mm}^2$

$\tau = 15\text{MPa} = 15\text{ N/mm}^2$

$\sigma_c = 50\text{MPa} = 50\text{N/mm}^2$

1. Side of the square rod

let

x = Each side of the square rod

Considering the failure of the rod in tension

$35000 = x^2 \times \sigma_t = x^2 \times 20 = 20x^2$

$x^2 = 35000/20 = 1750$ or $x = 41.8 \approx 42\text{mm}$

other dimensions are

$B_1 = x = 42\text{ mm}$

Thickness of cotter $t = B_1/4 = 42/4 = 10.5$ say 12mm

Thickness of the cotter = 12cm

height and length of the gib head (l_4)

Thickness of the cotter = 12mm

2. Width of the gib and cotter

let B = Width of gib and cotter

$55000 = 2B \times t \times N$

$B = \frac{55000}{560}$

$B = 97.2 = 100mm$

$b_1 = 0.55B = 0.55 \times 100 = 55mm$

$b = 0.45B = 0.45 \times 100 = 45mm$

3. Thickness of strap

t_1 = thickness of the strap

$55000 = 2(2 \times t_1 - t_1 \times t)\sigma_t$

$55000 = 1800t_1$

$t = 30mm$

Now the induced stress may be

$55000 = 2t_1 \times t \times \sigma_c = 2 \times 50 \times 12 \times \sigma_c = 720\sigma_c$

$\sigma_c = \frac{35000}{720}$

$\sigma_c = 48.6 N/mm^2$

4. Length of the end

$55000 = 2l_1 \times 2 \times N$

$55000 = 1260 l_1$

$l_1 = 48mm$

5. length of the spl

$35000 = 2 \times 0/_3 \times t_1 \times T$

$l_2 = 35000/1800$

$l_0 = 80mm$

length of the strap end

$= 8/_3 \times 1 = 8/_3 \times 4\theta = 88mm$

$41 = 4 \times 4\theta = 168mm$

8) A.

Given that

$P = 40KW = 40 \times 10^3 W$, $N = 350rpm$, $\tau_s = 40MPa = 40N/mm^2$

$\sigma_{cs} = 80$ MPa $= 80 N/mm^2$. $\tau_c = 15MPa = 15N/mm^2$

1. design of shaft

d = dia of the shaft

$$T = \frac{P \times 60}{2\pi N} = \frac{40 \times 10^3 \times 60}{2\pi \times 350} = 1100 N-m$$

5

$$= 1100 \times 10^3 N-mm$$

We also know that

$$1100 \times 10^3 = \pi/_{16} \times \tau_s \times d^3 = \pi/_{16} \times 40 \times d^3 = 7.86 d^3$$

$$d^3 = 1100 \times 10^3/7.86$$

$$= 140 \times 10^3 \text{ (or) } d = 55mm$$

4. design of the sleeve

$D = 2d + 13 mm$

$= 125 mm$

Length

$L = 3.5d = 3.5 \times 55$

$= 192.5 = 195 mm$

let us now check the induced

$$1100 \times 10^3 = \frac{\pi}{16} \times \tau_c \left[\frac{D^4 - d^4}{D}\right]$$

$$= 370 \times 10^3 \tau_c$$

$$2.97 \ N/mm^2$$

5. design of key.

Width of key $= (w) = 18 mm$

Thickness of key $= t = w = 18 mm$

Length $l = L/2 = 195/2 = 97.5 mm$

$$1100 \times 10^3 = l \times w \times \tau_s \times d/2$$

$$48.2 \times 10^3 \tau_s$$

Now considering

$$1100 \times 10^3 = l \times t/2 \times \sigma_c \times d/2$$

$$= 1100 \times 10^3 / 24.1 \times 10^3$$

$$= 45.6 \ N/mm^2$$

(5)

A.

Given that

$m = 20$, $t = 20000kg$, $v = 2 m/s$, $D = 300mm$,

$\delta = 250mm$, $\tau = 600MPa = 600 N/mm^2$

1. dia of spring wire

d = dia of the wire

$KE = \frac{1}{2} m v^2$

$= \frac{1}{2} \times 20000 (2)^2$

$= 40 \times 10^6 N\text{-}m \rightarrow (1)$

Energy stored in spring

$\frac{1}{2} \times W.\delta = 2 = W.\delta = W \times 250$

$= 250 W N\text{-}mm \rightarrow (2)$

Eqn (1) & (2)

$W = 40 \times 10^6 / 250 = 160 \times 10^3 N$

Torque transformed by spring

$T = W \times D/2 = 160 \times 10^3 \times \frac{300}{2}$

$= 24 \times 10^6 N\text{-}mm$

We also known that

$$84 \times 10^6 = \pi/16 \times \tau \times d^3$$

$$= 117.8 d^3$$

$$d^3 = 84 \times 10^6 / 117.8$$

$$d = 80 mm$$

2. No of turns of spring

n = No of active turns of spring

$$850 = \frac{8 W . D^3 . n}{G . d^4}$$

$$= 31.7 n$$

$$n = 850/31.7$$

$$n = 8$$

total No. of turns

$$n = n + 2 = 8 + 2 = 10$$

3. Free length of the spring

Free length of the spring

$$L_F = n' . d + \delta + 0.15 \delta = 10 \times 60 + 250 + 0.15 \times 250$$

$$= 887.5 mm$$

4. pitch of the coil

We know that pitch of the coil

$$= \frac{\text{free length}}{n - 1} = \frac{887.5}{10 - 1} = 98.6 mm$$

RISE KRISHNA SAI PRAKASAM

GROUP OF INSTITUTIONS.

department of Mechanical engg.

Assignment - 2

5

Roll No :- 178A1A0315

1. Design a sleeve and cotter joint to resist a tensile load of 60kN. All parts of the joint are made of the same material with the following allowable stresses:

$\sigma_t = 60$ Mpa; $\tau = 70$ Mpa; and $\sigma_c = 125$ Mpa.

Given: $P = 60$ KN $= 60 \times 10^3$ N; $\sigma_t = 60$ Mpa $= 60$ N/mm²; $\tau = 70$ Mpa $= 70$ N/mm²

$\sigma_c = 125$ Mpa $= 125$ N/mm²

1. Diameter of the rods:=

let

d = diameter of the rods.

considering the failure of the rods in tension. we know that load(P),

$$60 \times 10^3 = \frac{\pi}{4} \times d^2 \times \sigma_t = \frac{\pi}{4} \times d^2 \times 60 = 47.13 d^2$$

$$\therefore d^2 = 60 \times 10^3 / 47.13 = 1273 \text{ or } d = 35.7 \text{ say } 36 \text{ mm}.$$

2. Diameter of enlarged end of rod and thickness of cotter:=

let d_2 = diameter of enlarged end of rod, and

t = Thickness of cotter. It may be taken as $d_2/4$.

considering the failure of the rod in tension across the weakest section (i.e. slot). we know that load (P),

4. Width of cotter:-

Let b = width of cotter.

Considering the failure of cotter in shear. Since the cotter is in double shear, therefore load (P),

$60 \times 10^3 = 2b \times t \times \tau = 2 \times b \times 11 \times 70 = 1540b$

$\therefore b = 60 \times 10^3 / 1540 = 38.96$ say 40mm

5. Distance of the rod from the beginning to the cotter hole:-

Let a = Required distance.

Considering the failure of the rod end in shear. Since the rod end is in double shear, therefore load (P).

$60 \times 10^3 = 2a \times d_2 \times \tau = 2a \times 44 \times 70 = 6160a$.

$\therefore a = 60 \times 10^3 / 6160 = 9.74$ say 10mm.

6. Distance of the rod end from its end to the cotter hole:-

Let c = Required distance.

Considering the failure of the sleeve end in shear. Since the sleeve end is in double shear, therefore load (P),

$60 \times 10^3 = 2(d_1 - d_2) c \times \tau = 2(60-44) c \times 70 = 2240c$

$\therefore c = 60 \times 10^3 / 2240$

$= 26.78$ say 28mm

Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90kw 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.

1. Design for hub:-

we know that the outer diameter of hub,

$D = 2d = 2 \times 80 = 160\ mm$ and length of hub,

$L = 1.5d = 1.5 \times 80 = 120mm$

Let us now check the induced shear stress in the hub by considering it as a hallow shaft. the shear stress for the hub material (which is cast iron) is usually 14Mpa. we know that the torque transmitted(T).

$$3440 \times 10^3 = \pi/16 \times \tau_c \left[\frac{D^4 - d^4}{D}\right] = \pi/16 \times \tau_c \left[\frac{(160)^4 - (80)^4}{160}\right]$$

$$= 754 \times 10^3 \tau_c$$

$$\therefore \tau_c = 3440 \times 10^3 / 754 \times 10^3 = 4.56\ N/mm^2 = 4.56\ Mpa$$

Since the induced shear stress for the hub material is less than 14Mpa, therefore the design for hub is safe.

2. Design for key:-

From Table 13.1, we find that the proportions of key for a 80mm diameter shaft are:

width of key $w = 25mm$

and thickness of key $t = 14mm$

The length of key(l) is taken equal to the length of hub(L).

$\therefore l = L = 120mm$

Assuming that the shaft and key are of the same material. Let us Now check the induced shear stress in key. we know that the torque transmitted (T),

$$3440 \times 10^3 = l \times w \times \tau_K \times d/2 = 120 \times 25 \times \tau_K \times \frac{80}{2}$$

$$= 120 \times 10^3 \tau_K$$

$\tau_K = 3440 \times 10^3 / 120 \times 10^3 = 28.7\ N/mm^2 = 28.7\ Mpa$

$D_2 = 4\ d = 4 \times 80 = 320mm$

Thickness of protective circumferential flange,

$$t_p = 0.25d = 0.25 \times 80 = 20mm.$$

3. A helical torsion spring of mean diameter 60mm is made of a round wire of 6mm diameter. If a torque of 6N-m is applied on the spring, find the bending stress induced and the angular deflection of the spring in degrees. The spring index is 10 and modulus of elasticity for the spring material is 200kN/mm2. The no. of effective turns may be taken as 5.5.

Sol: Given $D = 60mm$ $d = 6mm$ $M = 6\ N\text{-}m = 6000\ N\text{-}mm$; $C = 10$

$E = 200 kN/mm^2 = 200 \times 10^3 N/mm^2$ & $n = 5.5$.

Bending stress induced:-

we know that wahl's stress factor for a spring made of round wire,

$$K = \frac{4c^2 - c - 1}{4c^2 - 4c} = \frac{4 \times 10^2 - 10 - 1}{4 \times 10^2 - 4 \times 10} = 1.08$$

∴ Bending stress induced,

$$\sigma_b = K \times \frac{32m}{\pi d^3} = 1.08 \times \frac{32 \times 6000}{\pi \times 6^3} = 305.5\ N/mm^2 \text{ or } MPa$$

Angular deflection of the spring:-

we know that the angular deflections of the spring

$$\theta = \frac{64 M \cdot D \cdot n}{E \cdot d^4} = \frac{64 \times 6000 \times 60 \times 5.5}{200 \times 10^3 \times 6^4} = 0.49\ rad$$

$$= 0.49 \times \frac{180}{\pi} = 28^\circ$$