AUTOMOBILE COMPONENT DESIGN

TH-05

BRANCH-AUTOMOBILE COMPONENT DESIGN

SEMESTER-5TH

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Unit-1 (Introduction)

- 2 Mark

1. What do you mean by Factor of safety?
2. Define working Stress.
3. Define ultimate Stress.
4. Define ductility.
5. Define stiffness.
6. Define Creep.
7. Define Strength.
8. Define Machinability.
9. Define Fatigue.
10. Define Elasticity.

5 Marks

1. Define load and state types of load acting upon a machine element?
2. Describe various mechanical properties of the material?

10Marks

1. Draw a flow chart for the general procedure in machine design and explain in brief?
2. General consideration in machine design explain?

Design of Fastening Elements

Unit -2

2 Marks

1. Define Welding joints.
2. Define riveted joint.
3. Define types of Welding joint.
4. State joint and their classification.
5. Different between pitch and lead of a thread.
6. Define efficiency of riveted joint.
7. What is the material used for rivets.

5 Marks

1. What are the advantages of welding joint over riveted joints?
2. Describe of failures of riveted joint?
3. State types of riveted joints and types of rivets?
4. Assumption in longitudinal boiler joints?

10 Marks

1. A double riveted double cover butt joint in plates 20mm thick is made with 25mm diameter rivets at 100mm pitch. The permissible stresses are σ_t=120mpa; τ = 100mpa and σ_c =150mpa. Find the efficiency of joint , taking the strength of the riveted in double shear as twice then that of single shear?
2. A double riveted lap joint with Zig-Zag riveting is to be design for 13mm thick plates assume σ_t = 80mpa ; τ = 60mpa; σ_c State how the joint will fail and find the efficiency of the joint ?
3. A plate 100mm wide and 12.5mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50kn. Find the length of the weld so that the maximum stresses doesn't exceed 56mpa.Consider the joint 1st under static loading then under fatigue loading?
4. A plate 100mm wide and 10mm thick is to be welded too another plate by means of double parallel fillets. The plates are subjected to a static load of 80kn. Find the length of weight if the permissible shear stress in the weld doesn't exceed 55mpa.?

Design of Shafts and Keys

Unit-3

2 Marks

1. What is function of shaft?
2. What is the difference between shaft and Axle?
3. What is the function of key?
4. State the material used for shaft?

5Marks

1. Describe the effect of key way?
2. Write good properties of material used for shaft?
3. Explain types of key?
4. Design rectangular sunk key by using empirical relation for given diameter of shaft?

10 Marks

1. Design the rectangular key for a shaft of 50mm diameter. The shearing and crushing stresses for the key material are 42mpa and 70mpa?
2. A solid circular shaft is subjected to a bending moment of 3000 N-m and torque of 10,000 N-m. The shaft is made 45C8 steel having ultimate tensile stresses of 700mpa and a ultimate shear stresses of 500mpa. Assuming a factor of safety as 6, determine the diameter of the shaft. ?
3. Find the diameter of a solid steel shaft to transmit 20kw at 200r.p.m. The ultimate shear stresses for the steel may be taken as 360mpa and a factor safety 8.

If a Hollow shaft is to be used in a place of the solid shaft find the inside and outside diameter when the ratio of inside to outside diameter is 5.?

Design of Coupling

Unit-4

2 Marks

1. State types of Coupling?
2. Define the function of a shaft Coupling.
3. State types of shaft Coupling.
4. Define rigid Coupling.
5. Define Flexible Coupling.

5 Marks

1. Describe the function of a Coupling give at least 5 practical application?
2. State recruitment of a good shaft Coupling?
3. What are the flexible Coupling and what are their application?
4. Describe the types of various shafts coupling mentioning the uses of each type?

10 Marks

1. Design a clamp coupling to transmit 30kw at 100 r.p.m. The allowable shear stresses for the shaft and key is 40mpa and the number of bolts connecting the two halves are six. The permissible tensile stresses for the bolts is 70mpa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3?
2. Design and make a net dimensioned sketch of muff coupling which is used to connect two steel shafts transmitting 40 kw at350 r.p.m . The material for the shafts and key is plain carbon steel for which allowable shear and crushing stress 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.?

DESIGN A CLOSSED COIL HELICAL SPRING

Unit-5

2 Marks

1. Define function of the spring.
2. State the Formula for stress in helical spring of a circular wire?
3. Define spring constant.
4. Define spring index..
5. What is solid length of a spring?
6. Define free length of a spring.
7. What is curvature effect in helical spring?

5Marks

1. Write short notes Surge in spring?
2. Explain what do you understand by A.M Wahl's Factor and state its importance is design of helical spring?
3. Derive expression of spring rate of helical spring of a circular wire?

10Marks

1. A helical spring is made from a wire of 6mm diameter and has outside diameter of 85mm. If the permissible shear stresses modulus of 94 kn/mm^2. Find axial load which the spring can carry and deflection per active turn? Neglecting effect of curvature?
2. Design a spring for a balance to measure 0 to 1000N over a scale of length 80mm. The spring is to be enclosed in a casing of 25mm diameter. The approximate number of turns is 30. The modules of rigidity are 85 kn/mm^2. Also calculate the maximum shear stress induced?
3. Design a helical compression spring for a maximum load of 1000 N for a deflection of 25mm using the value of spring index as 5.?

   The maximum permissible shear stress for spring wire is 420mpa and modules of rigidity is 84Kn/mm^2.?

SUBJECT – AUTOMOBILE COMPONENT DESIGN

MCQ ON DESIGN OF SHAFT, KEY AND COUPLING

1. A transmission shaft subjected to pure bending moment should be designed on the basis of
   a. Maximum principal stress theory
   b. Maximum shear stress theory
   c. Distortion energy theory
   d. Goodman or Soderberg diagrams

   Answer: Option A

2. A transmission shaft is subjected to bending moment (Mb) and torsional moment (Mt). The equivalent torsional moment is given by,
   (A) √(Mb + Mt)
   (B) √(Mb2 + Mt2)
   (C) Mb + Mt
   (D) Mb +√(Mb2 + Mt2)

   Answer: Option B

3. The standard height for flat key in terms of shaft diameter (D) is,
   (A) d
   (B) d/2
   (C) d/4
   (D) d/6

   Answer: Option D

4. Kennedy key is used in
   (A) Light duty applications
   (B) Heavy duty applications
   (C) High speed applications
   (D) Precision equipments

   Answer: Option B

5. A bushed-pin type flange coupling is used
    (A) For intersecting shafts
    (B) When the shafts are not in exact alignment
    (C) For small shafts rotating at slow speeds
    (D) For parallel shafts

    Answer: Option B

6. 8. The standard length for square or flat key in terms of shaft diameter (D) is,
    (A) d
    (B) 2d
    (C) 1.5d
    (D) 2.5d

    Answer: Option C

7. 9. The key, which fits in the keyway of hub, only is called,
    (A) Saddle key
    (B) Feather key
    (C) Woodruff key
    (D) Kennedy key

    Answer: Option A

8. 10. Splines are used if,
    (A) The power to be transmitted is high
    (B) The torque to be transmitted is high
    (C) The speed is high
    (D) There is relative motion between shaft and hub

    Answer: Option D

9. 11. The shafts will have same strength on the basis of torsional rigidity, if
    (A) Diameter and length of both shafts is same
    (B) Material of both shafts is same
    (C) Angle of twist for both shafts is same

(D) All of above conditions are satisfied

Answer: Option D

10. 13. The type of key used when the gear is required to slide on the shaft is
    (A) Sunk key
    (B) Feather key
    (C) Woodruff key
    (D) Kennedy key

    Answer: Option B

11. The keyway,
    (A) Reduces strength of shaft
    (B) Reduces rigidity of shaft
    (C) Increases stress concentration
    (D) All of above

    Correct Answer

    Answer: Option D

12. While designing a flange coupling, care is taken so that
    (A) Shaft is the weakest component
    (B) Bolts are the weakest component
    (C) Key is the weakest component
    (D) The flange is the weakest component

    Correct Answer

    Answer: Option C

13. 6. Splines are commonly used in
    (A) Machine tool gear box
    (B) Automobile gear box
    (C) Hoist and crane gear box
    (D) Bicycle

    Correct Answer

    Answer: Option B

14. 7. In case of clamp coupling, power is transmitted by means of,

(A) Friction force
(B) Shear resistance
(C) Crushing resistance
(D) None of the above

Correct Answer

Answer: Option A

15. 8. The angle of twist for a transmission shaft is inversely proportional to

(A) Shaft diameter
(B) (Shaft diameter)2
(C) (Shaft diameter)3
(D) (Shaft diameter)4

Correct Answer

Answer: Option D

16. 9. In case of sunk key,

(A) The keyway is cut in the shaft only
(B) The keyway is cut in the hub only
(C) The keyway is cut in both the shaft and the hub
(D) None of the above

Correct Answer

Answer: Option C

17. 10. The compressive stress induced in a square key is,

(A) Equal to shear stress
(B) Four times of shear stress
(C) Twice of shear stress
(D) Half of shear stress

Correct Answer

Answer: Option C

18. While designing a shaft, key and hub, care is taken so that

(A) Shaft is the weakest component

(B) Key is the strongest component

(C) Key is the weakest component

(D) The hub is the weakest component

b. Correct Answer

c. Answer: Option C

19. The function of key is

(A) To connect transmission shaft to a rotating machine elements like gears

(B) To transmit torque from shaft to hub and vice versa

(C) To prevent relative rotational motion between the shaft and the connected element

(D) All of above three functions

Correct Answer

Answer: Option D

20. A flange coupling is used

(A) For intersecting shafts

(B) For collinear shafts

(C) For small shafts rotating at slow speeds

(D) For parallel shafts

Correct Answer

Answer: Option B

21. The standard taper for sunk key is

(A) 1 in 100

(B) 1 in 50

(C) 1 in 10

(D) 1 in 1000

Correct Answer

Answer: Option A

22. The standard width for square or flat key in terms of shaft diameter (D) is,

(A) d
(B) d/2
(C) d/4
(D) d/8

Correct Answer

Answer: Option C

23. In case of saddle key

(A) The keyway is cut in the shaft only
(B) The keyway is cut in the hub only
(C) The keyway is cut in both the shaft and the hub
(D) None of the above

Correct Answer

Answer: Option B

24. 9. The key, which consists of two square keys, is called,

(A) Saddle key
(B) Feather key
(C) Woodruff key
(D) Kennedy key

Correct Answer

Answer: Option D

25. 10. A muff coupling is

(A) Rigid coupling
(B) Flexible coupling
(C) Shock absorbing coupling
(D) None of the above

Correct Answer

Answer: Option A

MCQ ON DESIGN OF A CLOSED COIL HELICAL SPRING

Q1. Design a spring for

(a) Higher strength

(b) Higher deflection

(c) Higher stiffness

(d) None

(Ans: b)

Q2. Design a carriage spring on the basis of

(a) Shear

(b) Compression

(c) Bending

(d) None

(Ans: c)

Q3. Design a closed helical spring under axial load on the basis of

(a) Shear

(b) Compression

(c) Bending

(d) None

(Ans: a)

Q4. Design a closed helical spring under axial torque on the basis of

(a) Shear

(b) Compression

(c) Bending

(d) None

(Ans: c)

Q5. Design an open helical spring under axial torque on the basis of

(a) Shear

(b) Compression

(c) Bending

(d) None

(Ans: d)

Q6. Spring index is

(a) D – d

(b) D/d

(c) D2 –d2

(d) None

(Ans: b)

Q7. Wahl's stress concentration factor is

(a) (4C – 1)/ (4C – 3) + 0.615/C

(b) (4C – 1)/ (4C – 2) + 0.615/C

(c) (4C – 1)/ (4C – 4) + 0.615/C

(d) None

(Ans: c)

(c) Strain energy per unit mass

(d) None

(Ans: d)

Q8. Wahl's stress concentration factor accounts for

(a) Shear effect

(b) Bending effect

(c) Compression effect

(d) none

(Ans: b)

Q9. There are number of laminations in a

(a) Close coiled spring

(b) Open coiled spring

(c) Spiral spring

(d) None

(Ans: d)

Q10. Most important features of a spring

(a) Deflection, stiffness and strength

(b) Stiffness, bending and shear strengths

(c) Strain energy, deflection and strength

(d) None

(Ans: c)

Q11. Value of Wahl's stress concentration factor is always

(a) > 1

(b) = 1

(c) < 1

(d) None

(Ans: a)

Q12. The most common value of spring index lies between

(a) 0 and 5

(b) 5 and 10

(c) 10 and 15

(d) None

(Ans: b)

Q13. Use laminated springs in

(a) Watches

(b) Sofas

(c) Motorcycles

(d) None

(Ans: d)

Q14. Use leaf springs in

(a) Scooters

(b) Bikes

(c) Trucks

(d) None

(Ans: c)

Q16. Leaf springs use

(a) All full length leaves

(b) All leaves of different lengths

(c) Few full length leaves with truncated leaves

(d) None

ANS: (c)

Q17. Design leaf springs on the basis of

(a) Maximum bending stresses

(b) Maximum deflection

(c) Maximum bending & maximum deflection

(d) None

(Ans: c)

Q18. Maximum bending stress in a leaf spring is

(a) 3WL/4nbt2

(b) 3WL/8nbt2

(c) 3WL/2nbt2

(d) None

(Ans: c)

Q19. Maximum deflection in a leaf spring is

(a) 3WL3/4Enbt3

(b) 3WL3/8Enbt3

(c) 3WL3/16Enbt3

(d) None

(Ans: b)

Q20. Overlap in a leaf spring is

(a) L/n

(b) L/2n

(c) L/3n

(d) None

(Ans: b)

Q21. Strain energy in a leaf spring is

(a) W x δ

(b) W x δ/3

(c) W x δ/2

(d) None

(Ans: c)

Q22. Angle of helix in a close coiled spring is

(a) < 100

(b) >100

(c) =100

(d) None

(Ans: a)

Q23. A close coiled spring under axial load produces

(a) Bending stresses

(b) Shear stresses

(c) Tensile stresses

(d) None

(Ans: b)

Q24. Deflection in a spring should be

(a) Large

(b) Medium

(c) Small

(d) None

(ANs: a)

Q25. Spring is an

(a) Elastic device

(b) Plastic device

(c) Elastic & plastic device

(d) None

(Ans: a)

Q26. Shear stress in a close coiled helical spring is

(a) 16WD/π d3

(b) 32WD/π d3

(c) 8WD/π d3

(d) None

(Ans: c)

Q27. Deflection in a close coiled helical spring is

(a) 16 WR3n/Gd4

(b) 32 WR3n/Gd4

(c) 64 WR3n/Gd4

(d) None

(Ans: c)

Q28. Strain energy in a close coiled helical spring is

(a) τ2/8G

(b) τ2/16G

(c) τ2/4G

(d) None

(Ans: c)

Q29. Strain energy in a spring should be

(a) Large

(b) Small

(c) Zero

(d) None

(Ans: a)

Q30. Deflection in a spring should be

(a) Large

(b) Small

(c) Zero

(d) None

(Ans: a)

MCQ ON DESIGNING FASTENING ELEMENT

1. The transverse fillet welds are designed for
   a. Tensile strength
   b. Shear strength
   c. Bending strength
   d. Compressive strength

   Correct Answer

   Answer: Option A

2. The transverse fillet welds are designed for
   (A) Tensile strength
   (B) Shear strength
   (C) Bending strength
   (D) Compressive strength

   Correct Answer

   Answer: Option A

3. Rivets are usually made of

(A) Conformable material
(B) Hard material
(C) Brittle material
(D) Ductile material

Correct Answer

Answer: Option D

4. 8. Flat head rivets are used in
   (A) Ship hulls
   (B) Light sheet metal work
   (C) Structural work
   (D) Air conditioning ducts

   Correct Answer

   Answer: Option B

5. 9. The principle of applying heat and pressure is used in
   (A) Spot welding
   (B) Seam welding
   (C) Electric resistance welding
   (D) All three methods

   Correct Answer

   Answer: Option D

6. 10. A rivet is specified by
   (A) Shank diameter
   (B) Length of rivet
   (C) Type of head
   (D) Material of rivet

   Correct Answer

   Answer: Option A

7. 12. In single riveted lap joint, the rivet is subjected to
   (A) Double shear
   (B) Single shear
   (C) Either single or double shear
   (D) Tensile stress

   Correct Answer

   Answer: Option B

8. 13. The purpose of circumferential lap joint in boiler shell is
   (A) To make cylindrical ring from steel plate
   (B) To increase the length of boiler shell by connecting one ring to another
   (C) To make diameter and length of boiler shell
   (D) To connect openings to shell

Correct Answer

Answer: Option B

9. A rivet head used in boilers and pressure vessels is
   a. Snap head
   b. Countersunk head
   c. Flat head
   d. Half countersunk head

   Correct Answer

   Answer: Option A

10. The objective of caulking and fullering is to make the riveted joint,
   a. Free from residual stresses
   b. Leak proof
   c. Strong
   d. Permanent

   Correct Answer

Answer: Option B

11. Which of the double-strap butt joint used in boiler shell has highest efficiency?
    a. Single-riveted
    b. Double-riveted
    c. Triple-riveted
    d. Quadruple-riveted

    Correct Answer

    Answer: Option D

12. In fillet welded joint, the throat of weld as compared to the size of weld is
    a. About 0.5 times
    b. About 0.707 times
    c. About same size
    d. About $\sqrt{2}$ times

    Correct Answer

    Answer: Option B

13. The distance between the center of one rivet and the center of adjacent rivet in the same row is called
    a. Pitch
    b. Margin
    c. Transverse pitch
    d. Diagonal pitch

    Correct Answer

    Answer: Option A

14. A lap joint is always subjected to
    (A) Bending moment

(B) Torsional moment
(C) Tensile force
(D) Compressive force

Correct Answer

Answer: Option A

15. 2. Rivets are usually made of
(A) High carbon steel
(B) Alloy steel
(C) Cast iron
(D) Mild steel

Correct Answer

Answer: Option D

16. 4. Pan Head rivets are used in
(A) Ship hulls
(B) Light sheet metal work
(C) Structural work
(D) Air conditioning ducts

Correct Answer

Answer: Option A

17. The shear resistance of one rivet in double shear is
a. 2.5 times its resistance in single shear
b. Two times its resistance in single shear
c. 1.875 times its resistance in single shear
d. 1.5 times its resistance in single shear

Correct Answer

Answer: Option C

18. The shear resistance of one rivet in double shear is

a. 2.5 times its resistance in single shear
b. Two times its resistance in single shear
c. 1.875 times its resistance in single shear
d. 1.5 times its resistance in single shear

Correct Answer

Answer: Option C