P P SAVANI UNIVERSITY

Sixth Semester of B. Tech. Examination

May 2022

SEME 3060 Design of Basic Machine Elements

17.05.2022, Tuesday **Time: 09:00 a.m. To 11:30 a.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in same answer sheet.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1 Answer the Following: (MCQ/Short Question/Fill in the Blanks) **[05]**

(i) Which design consideration deals with the appearance of the product?

a) System design b) Ergonomics
c) Aesthetics d) Creative design

(ii) Rankine's theory of failure is applicable for the following type of materials

a) brittle b) plastic
c) ductile d) elastic

(iii) Failure of a material is called fatigue when it fails

a) below the elastic limit b) below the yield point
c) at the elastic limit d) at the yield point

(iv) In a unilateral system of tolerance, the tolerance is allowed on

a) one side of the actual size b) one side of the nominal size
c) both sides of the actual size d) both sides of the nominal size

(v) In a close coiled helical spring, the spring index is given by D/d where D and d, are the mean coil diameter and wire diameter respectively. For considering the effect of curvature, the Wahl's stress factor K is given by

a) $\frac{4C-1}{4C+4}+\frac{0.615}{C}$ b) $\frac{4C-1}{4C-4}+\frac{0.615}{C}$
c) $\frac{4C+1}{4C-4}-\frac{0.615}{C}$ d) $\frac{4C+1}{4C+4}-\frac{0.615}{C}$

(vi) A leaf spring in automobiles is used

a) to apply forces b) to measure forces
c) to absorb shocks d) to store strain energy

(vii) Thermoplastic materials are those materials which

a) are used as a friction lining for clutches and brakes
b) do not become hard with the application of heat and pressure and no chemical change occurs
c) are formed into shape under heat and pressure and results in a permanently hard product
d) are flexible and can withstand considerable wear under suitable conditions

Q - 2 (a) Discuss the importance of selection of materials in machine design. **[05]**

Q - 2 (b) Why metals in their pure form are unsuitable for industrial purpose? **[05]**

OR

Q - 2 (a) What is concurrent engineering? Distinguish between concurrent engineering and sequential design. **[05]**

Q - 2 (b) Explain stress- strain diagram for ductile and brittle material with neat sketch. **[05]**

Q - 3 (a) What is allowable stress? How will you find out the allowable stress for brittle and ductile parts using factor of safety **[05]**

Q - 3 (b) Two rods are connected by means of cotter joint. The inside diameter of socket and outside diameter of socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 (S_{yt}= 400N/mm^2) and the factor of safety is 4. The width of the cotter is five times of thickness. Calculate: **[05]**

I. width and thickness of the cotter on the basis of shear failure

II. width and thickness of the cotter on the basis of bending failure.

OR

Q - 3 (a) What is meant by 'stress concentration'? Illustrate how the stress concentration in component can be reduced. **[05]**

Q - 3 (b) A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm^2. The bar is made of steel 40C8 (S_{ut} = 600 N/mm2). Calculate the life of the bar for a reliability of 90%. (Assume, Surface finish factor=0.44, size factor=0.85, reliability factor= 0.897) **[05]**

Q - 4 Attempt any one **[05]**

(i) Design a helical spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index 5, the maximum permissible shear stress of spring coil is 420 MPa and modulus of rigidity is 84 kN/mm^2.

(ii) What is nipping in a leaf spring? Discuss its role. List the materials commonly used for the manufacture of the leaf springs.

SECTION – II

Q - 1 Answer the Following: (MCQ/Short Question/Fill in the Blanks) **[05]**

(i) Two shafts A and B are made of same material. The diameter of shaft A is twice that of B. The torque transmitted by shaft A will be

a) twice that of B
b) Four times that of B
c) eight times that of B
d) Sixteen times that of B

(ii) In case of sunk keys. Power is transmitted by means of

a) Friction force
b) Shear resistance of key
c) Torsional shear resistance of key
d) Tensile force

(iii) Which of the following screw thread is adopted for power transmission in either direction?

a) square threads
b) Trapezoidal threads
c) Buttress threads
d) (a) and (b)

(iv) The coupler of turnbuckle has

a) Right hand threads on both ends
b) Left hand threads on both ends
c) Left hand threads on one end and right hand threads on other end
d) no threads

(v) The size of a fillet weld is given by,

a) throat of fillet
b) smaller side of triangle
c) hypotenuse of triangle
d) bigger side of triangle

(vi) Flat head rivets are used in

a) ship hulls
b) light sheet metal work
c) Structural work
d) air conditioning ducts

(vii) The friction material of the brake should have

a) high coefficient of friction
b) low coefficient of friction
c) high surface hardness
d) high endurance limit strenagth

Q - 2 (a) The layout of a transmission shaft carrying two pulleys B and C and supported on bearings A and D is shown in Fig.1. Power is supplied to the shaft by means of a vertical belt on the pulley B, which is then transmitted to the pulley C carrying a horizontal belt. The maximum tension in the belt on the pulley B is 2.5 kN. The angle of wrap for both the pulleys is 180° and the coefficient of friction is 0.24. The shaft is made of plain carbon steel 30C8 (S_{yt} = 400 N/mm^2) and the factor of safety is 3. Determine the shaft diameter on strength basis. **[05]**

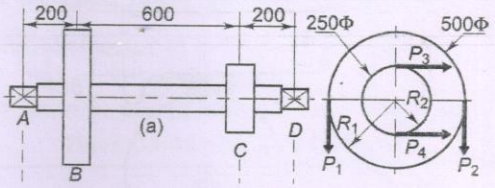

Figure 1

Q - 2 (b) Compare hollow shaft and solid shaft **[05]**

OR

Q - 2 (a) Define power screw and state its applications. **[05]**

Q - 2 (b) The nominal diameter of a triple-threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having an outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 15 kN. Using the uniform wear theory for collar friction, calculate: (i) torque required to raise the load; (ii) torque required to lower the load; and (iii) the force required to raise the load, if applied at a radius of 500 mm. **[05]**

Q - 3 (a) What are the advantages and disadvantages of threaded joints? **[05]**

Q - 3 (b) It is required to design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The rods are co-axial and a small amount of angular movement between their axes is permissible. Design the joint and specify the dimensions of its components. Assume factor of safety= 5, material is of plain carbon steel of grade 30C8 (S_{yt}=400N/mm²) **[05]**

OR

Q - 3 (a) A welded connection, as shown in Fig. 2 is subjected to an eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 100 N/mm². Assume static conditions. **[05]**

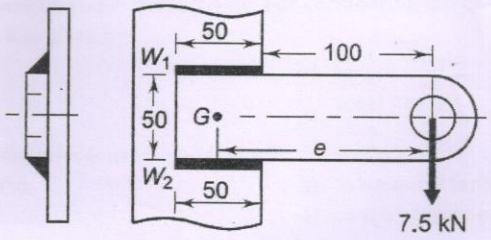

Figure 2

Q - 3 (b) A single block brake with a torque capacity of 250 N-m is shown in Fig.3. The brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Calculate (i) the actuating force and the hinge-pin reaction for clockwise rotation of the drum; (ii) the actuating force and hinge-pin reaction for anticlockwise rotation of the drum; (iii) the rate of heat generated during the braking action; and (iv) the dimensions of the block, if the intensity of pressure between the block and brake drum is 1 N/mm2. The length of the block is twice its width. State whether the brake is self-locking. **[05]**

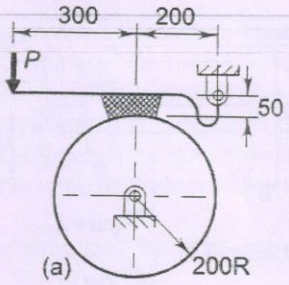

Figure 3

Q - 4 Attempt any one **[05]**

(i) Explain various types of rivet joints

(ii) Explain procedure for selection of Flat belt from Manufacturers catalogue

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