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GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, December – 2020

(Fifth Semester)

BMEPC 5040 – DESIGN OF MACHINE ELEMENTS

(Mechanical Engineering)

Time: 2 hrs Maximum: 50 Marks

(Prescribed Design Data Hand Books are permitted)

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) (1 x 10 = 10 Marks)

Q.1. Answer ***ALL*** questions

a. Stress concentration factor is defined as the ratio of
(i)Maximum stress to the endurance limit. (ii) Nominal stress to the endurance limit
(iii) Maximum stress to the nominal stress. (iv) Nominal stress to the maximum stress.

b. In static loading, stress concentration is more serious in
(i) ductile materials (ii) brittle materials
(iii)ductile as well as brittle materials (iv) elastic materials

c. Factor of safety for fatigue loading is the ratio of
(i) Elastic limit to the working stress (ii) Young's modulus to the ultimate strength
(iii) Endurance limit to the working stress. (iv)Elastic limit to linear deformation.

d. A rotating shaft carrying a uni-directional transverse load, is subjected to
(i) variable bending stress (ii) variable shear stress
(iii) constant bending stress (iv) constant shear stress

e. Soderberg and Goodman equations are concerned with the safety factors in case of
(i) static stresses (ii) variable stresses
(iii) stress concentration effect (iv) creep effect

f. The objective of caulking in a riveted joint is to make the joint
(i) Free from corrosion (ii) stronger in tension
(iii) free from stresses (iv) leak-proof

g. A cotter joint is used to transmit
(i) axial tensile load only (ii) axial compressive load only
(iii) combined axial and twisting loads (iv) axial tensile or compressive loads

h. For a square key made of mild steel, the shear and crushing strengths are related as
(i) Shear strength = crushing strength (ii) shear strength > crushing strength
(iii) Shear strength < crushing strength (iv) none of the above

i. Two shafts A and B of solid circular cross-section are identical except for their diameters d, the ratio of power transmitted by the shaft A to that of shaft B is

(i) $\frac{d_A}{d_B}$ (ii) $\frac{(d_A)^2}{(d_B)^2}$

(iii) $\frac{(d_A)^3}{(d_B)^3}$ (iv) $\frac{(d_A)^4}{(d_B)^4}$

j. When a helical compression spring is subjected to an axial compressive load, the stress induced in the wire is

(i) Tensile stress (ii) compressive stress

(iii) Shear stress (iv) bending stress

PART – B: (Short Answer Questions) (2 x 5 = 20 Marks)

Q.2. Answer ***ALL*** questions

a. Mention four important factors that influence the magnitude of factor of safety

b. Mention four method used to reduce stress concentration

c. What is meant by the efficiency of a riveted joint?

d. Why Wahl's factor is to be considered in the design of helical compression or tension springs?

e. What are flexible couplings and what are their applications ?

PART – C: (Long Answer Questions) (10 x 3 = 30 Marks)

Answer ***ANY THREE*** questions Marks

3. It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5, i.e. the design torque is 1.5 times of the rated torque. Select suitable materials for the various parts of the coupling, design the coupling and specify the dimension of its components. (10)

4.a. It is a required to design a square key for fixing a gear on a shaft of 25 mm diameter. The shaft is transmitting 15 kW power at 720 rpm to the gear. The key is made of steel 50C4 (σ_{yt} =460 N/mm^2) and the factor of safety is 3. For key material, the yield strength in compression can be assumed to be equal to yield strength is tension. Determine the dimensions of the key. (6)

b. What is Muff coupling ? Give its applications (4)

5. A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm². It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm². Calculate: 1. Diameter of the spring wire, 2. Mean coil diameter, 3. Number of active turns, and 4. Pitch of the coil. (10)

Take Wahl's factor, $K = \frac{4C-1}{4C-4} + \frac{0.615}{C} = 1.31$, where C is the spring index.

6. Determine rivet diameter, rivet pitch, distance between rows of rivets, strap thickness, and efficiency of a triple riveted double strap, chain butt joint, to join two plates of 15 mm thick. The permissible stresses are: σ_t =80MPa, σ_c =120MPa, and τ =60MPa. (10)

7. 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 (10)

1.the maximum principal stress;

2.The maximum shear stress; and

3. The maximum distortion strain energy theory of yielding.

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