Model Question Paper

SIXTH SEMESTER B.Tech DEGREE EXAMINATION

(2013 Scheme)

Branch: MECHANICAL PRODUCTION ENGINEERING

13.605 MACHINE THEORY AND DESIGN (P)

Time: 3 Hours **Max. Marks: 100**

***Instructions** : 1) Approved **data book** can be used.*

*2) **Any** missing data can be assumed suitably stating them properly.*

Part –A

Answer all questions

1. Briefly explain Modulus of Resilience and Modulus of Toughness.
2. What is the necessity for determining principal planes and principal stresses?
3. Derive the relation for maximum shear stress in plane state of stress.
4. State and explain St. Venant's Theory and Haigh theories of failure.
5. What is endurance limit? Explain.
6. .What are the different types of keys? Explain with sketches.
7. . How is shaft designed when it is subjected to twisting moment only?
8. .With the help of a neat sketch, briefly explain the various parts of a muff coupling.
9. .Determine the strength of double parallel fillet weld.
10. Discuss about nipping of leaf springs.

(10x2=20 Marks)

Part –B

Answer one full question from each module

Module-I

11. (a) Show that the state of stress at any point can be split into a hydrostatic part and a deviatoric part.
    (b) Derive the equations of equilibrium for a three – dimensional state of stress in differential form.

OR

12. Evaluate the principal stresses for the state of stress, $\tau_{ij} = \begin{bmatrix} 18 & 0 & 24 \\ 0 & -50 & 0 \\ 24 & 0 & 32 \end{bmatrix}$ MPa.

    Also determine the direction of maximum principal stress.

Module-II

13. The force acting on a bolt consists of two components, an axial pull of 12 kN and a transverse shear force of 5 kN. The bolt is made of C30 steel with yield strength 300 MPa and Poisson's ratio 0.25. Take factor of safety is 2. Determine the required diameter of the bolt using
    a) Maximum principal stress theory.
    b) Maximum principal strain theory.
    c) Maximum strain energy theory.

OR

14. A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N-m clockwise to 110 Nm counter clockwise and an applied bending moment at a critical section varies from 440 N-m to – 220 N-m. The shaft is of uniform cross section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and a 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 a surface finish factor of 0.62.

Module-III

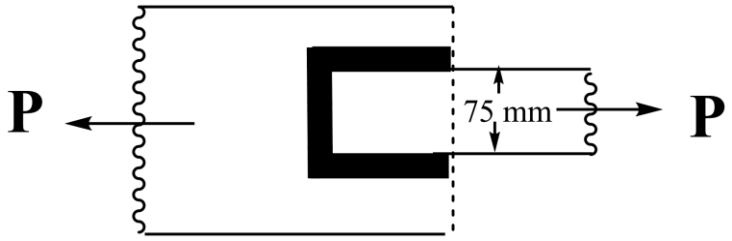
15. A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end carries two gears C and D located at distance 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure F_{tc} of the gear C and F_{td} of the gear D act vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gear C and D weights 950 N and 350 N respectively. The combined shock and fatigue factor for bending and torsion may be taken as 1.5 and 1.2 respectively.

OR

16. Design and draw 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^o in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. Take modulus of rigidity as 84 kN/mm^2.

Module-IV

17. 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 figure below. 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 fatigue loading.



OR

18. Design a leaf spring for a truck for the following specifications. Maximum load on the truck = 200 kN, Number of springs = 4, Maximum number of leaves = 12, Span of spring = 1200 mm. The permissible stress in the spring material is 700 MPa and permissible deflection is 100 mm.Tthe spring must have 2 extra full length leaves. Assume E= 210 x 10^3 MPa. Design for both conditions (a) with no initial stress. (b) with initial stress.

(4 x 20 = 80 Marks)