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4E 2049

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B.Tech. IV Semester (Main/Back) Examination -2012

Mechanical Engineering

4ME1 Design of Machine Elements – I

(Common for Mech. And P & I)

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **Five questions** selecting **one question** from each unit. All questions carry **equal marks**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.) Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) What are the common materials used in Mechanical Engineering Design? How can the properties of steel be improved.
b) State and illustrate two principal design rules for casting design.
c) What are fits and tolerances? How are they designated? **(6+4+6)**

2. a) What do you understand by the term “change in the shape of the designed element to facilitate its production”? Give at least ten examples through nice diagrams showing the designed shapes and then changes in design to facilitate production from turning, costing, forging, welding, handling, assembly, appearance etc. (at least one example from each of these).
b) A hole is dimensioned as $25^{+0.33}_{+0.0}$ and the shaft is dimensioned as $25^{-0.040}_{-0.061}$. Determine the hole tolerance, shaft tolerance and allowance of the fit. What type of fit shall be established. **(8+8)**

Unit - II

3. a) What do you mean by endurance strength of a material? How do the size and surface condition of a component and type of load effect such strength?

- b) A 45mm diameter shaft is made of steel with a yield strength of 40 N/mm^2 . A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 34 N/mm^2 is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2. (6+10)
4. a) Clearly define the term “stress concentration factor” giving at least one example.
 b) List the important factors that influence the magnitude of factor of safety.
 c) Discuss in detail the design procedure of a spigot and socket cotter joint. (4+4+8)

Unit - III

5. a) What is a lever? Explain the principal on which it works. Explain three types of levers.
 b) Design a bell crank lever of I section to carry a load of 1000 N. Use C.I for the lever with the permissible stress $\sigma_t = 20 \text{ MPa}$, $\sigma_c = 100 \text{ MPa}$, $\tau = 10 \text{ MPa}$, and steel for the fulcrum pin with the permissible stresses $\sigma_t = 90 \text{ MPa}$, $\sigma_c = 100 \text{ MPa}$, $\tau = 60 \text{ MPa}$ and allowable bearing pressure $P_b = 20 \text{ MPa}$. Take length of load arm and effort arm as 250 mm and 400 mm respectively. Also design the fulcrum pin assuming suitable connection type. (6+10)
6. a) What is nipping in leaf spring? Discuss its role. List the materials commonly used for manufacture of the leaf springs.
 b) A semi elliptical laminated leaf spring has an eye to eye span of 1.2 m and supports a central load of 20 kN. For the purpose three full length and six graduated leaves including master leaf are used. Width of the central band is 0.2m. The width to thickness ratio for each leaf is 6. The allowable stresses are 200 N/mm^2 , Take $E = 2 \times 10^5 \text{ N/mm}^2$. Calculate the sections of the leaves and deflection at full load if:
 i) Leaves are not stressed initially.
 ii) Leaves are stressed initially for equalised stresses at maximum load. (6+10)

Unit - IV

7. a) What are flexible couplings and what are their applications? Illustrate your answer with suitable examples and sketches.
- b) Design and sketch a muff coupling which is used to connect two shafts of steel transmitting 50 HP at 360 rpm. The material for shaft and key is plain carbon steel for which allowable shearing and crushing stresses may be taken as 40 N/mm^2 and 80 N/mm^2 respectively. The material for the muff is cast iron for which allowable shear and crushing stresses may be taken as 20 N/mm^2 and 60 N/mm^2 respectively. (6+10)
8. A shaft is supported on bearings A and B, 800 mm between centres. A 20° straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left hand bearing A, and a 700 mm diameter pulley is mounted on 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of wrap. The pulley also serves as a flywheel and weighs 2000 N. The maximum belt tension is 3000 N and the tension ratio is 3 : 1. Determine the maximum bending moment and the necessary shaft diameter if the allowable shear stress of the material is 40 MPa. (16)

Unit - V

9. a) For supporting a travelling crane in a workshop, the brackets are fixed on steel column as shown in fig. The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm. from the face of the column. The vertical face is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket determine the size of the bolt if the permissible value of the tensile stress for the bolt material is 84 N/mm^2 . Also find the cross section of the arm of the bracket which is rectangular.

