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**SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR**  
(AUTONOMOUS)

**B.Tech III Year I Semester Regular Examinations December-2021**

**DESIGN OF MACHINE ELEMENTS -I**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 60

(Answer all Five Units 5 x 12 = 60 Marks)

**UNIT-I**

- 1 a What do you mean by preferred numbers and explain the applications. L1 6M  
b What is meant by factor of safety? Explain how it can be used in design applications. L1 6M

OR

- 2 a Derive an expression for the impact stress induced due to a falling load. L5 6M  
b An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm<sup>2</sup> in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take  $E = 200 \text{ kN/mm}^2$ . L3 6M

**UNIT-II**

- 3 Define the following terms L1 12M  
i) Theoretical Stress concentration factor  
ii) Fatigue Stress concentration factor  
iii) Endurance limit with the effect of size, load and surface factors  
iv) Fatigue failure

OR

- 4 A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. L3 12M

**UNIT-III**

- 5 a Explain Stress in screw fasteners due to Combined Forces? L2 6M  
b Two machine parts are fastened together tightly by means of a 24 mm tap bolt. If the load tending to separate these parts is neglected, find the stress that is set up in the bolt by the initial tightening. L1 6M

OR

- 6 a What is an eccentric loaded welded joint? Discuss the procedure for designing such a joint. L2 6M  
b A plate 100 mm wide and 10 mm thick is to be welded to another plate by means of double parallel fillets. The plates are subjected to a static load of 80 kN. Find the length of weld if the permissible shear stress in the weld does not exceed 55 MPa. L3 6M

**UNIT-IV**

- 7 a What are the applications of a cottered joint? L1 6M  
b A knuckle joint is required to withstand a tensile load of 25 kN. Design the joint if the permissible stresses are  $\sigma_t = 56 \text{ MPa}$ ;  $\tau = 40 \text{ MPa}$  and  $\sigma_c = 70 \text{ MPa}$ . L2 6M

**OR**

- 8 a A solid shaft is transmitting 1 MW at 240 r.p.m. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa. **L3 6M**
- b A steel spindle transmits 4 kW at 800 r.p.m. The angular deflection should not exceed  $0.25^\circ$  per metre of the spindle. If the modulus of rigidity for the material of the spindle is 84 GPa, find the diameter of the spindle and the shear stress induced in the spindle. **L3 6M**

**UNIT-V**

- 9 a What is the effect of keyway cut into the shaft? **L2 6M**
- b A 45 mm diameter shaft is made of steel with yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 340 MPa 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. **L2 6M**

**OR**

- 10 Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows : **L3 12M**
- The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
  - The allowable shear stress for cast iron is 15 MPa.
  - The allowable bearing pressure for rubber bush is  $0.8 \text{ N/mm}^2$ .
  - The material of the pin is same as that of shaft and key
- Draw neat sketch of the coupling.

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