

## II B. TECH II SEMESTER REGULAR EXAMINATIONS, AUGUST 2021 DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 60

Note: Answer **ONE** question from each Unit (**5 × 12 = 60 Marks**)

### UNIT - I

1. a) What is the importance of Factor of Safety in Machine Design. [4M]
- b) State and explain at least three theories of elastic failure under static load. Also state which theory is most suitable for ductile and brittle materials with reasons. [8M]

(OR)

2. a) Explain the factors to be considered in Machine Design. [2M]
- b) The shaft of an overhang crank subjected to a force P of 1kN is shown in Figure-1. The shaft is made of plain carbon steel 45C8 and the tensile yield strength is  $380\text{N/mm}^2$ . The factor of safety is 2. Determine the diameter of the shaft using the maximum shear stress theory. (All dimensions are in mm) [10M]

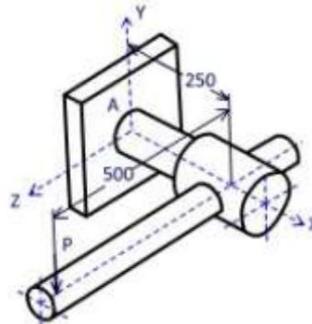


Figure-1

### UNIT – II

3. a) Explain various methods to reduce stress concentration factors. [4M]
- b) A shaft made of steel having ultimate tensile strength of 700 MPa and yield point 420 MPa is subjected to a torque of 2000 N-m clockwise to 600 N-m anti-clockwise. Calculate the diameter of the shaft if the factor of safety is 2 and it is based on the yield point and the endurance strength in shear. [8M]

(OR)

4. a) Explain different types of Alternative stresses. [4M]
- b) A plate made of steel 20CB ( $S_{ut}=440\text{N/mm}^2$ ) in hot rolled and normalized condition is shown in Figure-2. It is subjected to a completely reversed axial load of 30kN. The notch sensitivity factor q can be taken as 0.8 and the expected reliability is 90%. The size factor is 0.85. The factor of safety is 2. Determine the plate thickness for infinite life. [8M]

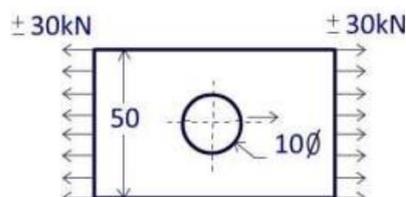


Figure-2

UNIT – III

5. A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in the Figure-3. The bolts are made from plain carbon steel 45C8 (yield strength  $S_{yt}=380 \text{ N/mm}^2$ ) and the factor of safety is 3. Specify the size of the bolts. (All dimensions are in mm) [12M]

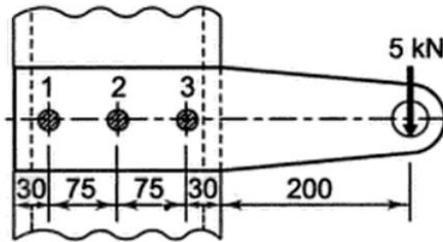


Figure-3

(OR)

6. a) Explain the advantages and disadvantages of welded joints over riveted joints. [4M]  
 b) Steel plates of 7 mm thickness are connected by a triple riveted lap joint of Zig-zag pattern. Compute the rivet diameter, rivet pitch and distance between rows of rivets for the joint. The permissible working stresses are tensile stress 90 MPa, shear stress 60 MPa and compressive stress 120 MPa. [8M]

UNIT –IV

7. a) Define equivalent torsional moment and equivalent bending moment. [4M]  
 b) List various types of keys and explain the design process of key [ 8M]

(OR)

8. A protective flange coupling is used to connect two shafts and transmit 7.5 kW power at 720 rpm. The design torque is 150 % of the rated torque. The shafts and bolts are made of plain carbon steel 30C8 ( $S_{yt} = 400 \text{ N/mm}^2$ ) and the factor of safety is 5. Assume  $S_{yc} = 1.5 S_{yt}$  and  $S_{sy} = 0.5 S_{yt}$ . The flanges are made of cast iron. Calculate: (i) diameter of the shafts (ii) number of bolts and (iii) diameter of bolts. [12M]

UNIT –V

9. a) Describe the purpose of gib in cotter joint. What are the applications of cotter joints? [8M]  
 b) Design a socket and spigot type of cotter joint to sustain an axial load of 100kN. The material selected for the joint has the following design stresses.  $\sigma_t = 120 \text{ MPa}$ ,  $\sigma_c = 160 \text{ MPa}$  and  $\tau = 60 \text{ MPa}$ . [4M]

(OR)

10. a) Define (i) Spring stiffness (ii) Pitch of the spring [2M]  
 b) A Helical spring is made from a wire of 6 mm diameter and has mean diameter of 69 mm. If the permissible shear stress is  $350 \text{ N/mm}^2$  and modulus of rigidity is  $84 \text{ kN/mm}^2$ , find the axial load which the spring can carry and the deflection per active turn by (i) Neglecting the effect of curvature and (ii) Considering the effect of curvature. [10M]

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