

# CBCS SCHEME

18MT52

## Fifth Semester B.E. Degree Examination, Jan./Feb. 2021 Design and Analysis of Machine Elements

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- Define machine design and explain classification of machine design. (07 Marks)
  - Explain factors to be considered while designing machine. (07 Marks)
  - Define factor of safety and explain codes and standards. (06 Marks)

OR

- Define stress concentration and explain methods of reducing stress concentration. (06 Marks)
  - A bar of rectangular section is subjected to an axial pull of 500kN as shown in Fig.Q2(b). Calculate its thickness if the allowable tensile stress in the bar is 200MPa.

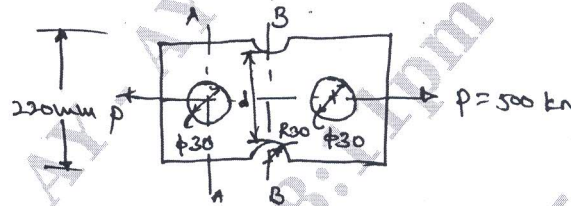


Fig.Q2(b)

- Explain maximum normal stress theory and maximum shear stress theory. (08 Marks) (06 Marks)

### Module-2

- Sketch and explain S.N. Diagrams. (06 Marks)
  - Define endurance limit and explain effect of factors on endurance limit. (07 Marks)
  - A piston rod is subjected to a maximum reversed axial load of 110kN. It is made of steel having an ultimate stress of  $900\text{N/mm}^2$  and the surface is machined. The average endurance limit is 50% of the ultimate strength. Take the size correction coefficient as 0.85 and factor of safety = 1.75. Determine the diameter of the rod. ( $e_L = 0.7$  and  $e_{Sr} = 0.78$ ). (07 Marks)

OR

- Sketch and explain cumulative fatigue damages. (06 Marks)
  - Explain Goodman and Soderberg relationship. (07 Marks)
  - A steel rod of ultimate strength  $600\text{N/mm}^2$  and yield strength  $400\text{N/mm}^2$  is subjected to a cyclic torque ranging from 350N-m to -100N-m. Calculate the diameter of the rod. Torsional yield stress =  $70\% \sigma_y$ . Average endurance limit = 50%. Shear stress concentration factor = 1.3. Factor of safety = 1.8. (07 Marks)

### Module-3

- Explain with neat sketch different types of power screws. (06 Marks)
  - Derive an expression for torque required to lift the load on square threaded screw. (06 Marks)
  - Write complete design procedure of power screw. (08 Marks)

OR

- 6 a. Derive an expression for stress in helical springs of circular wire. (06 Marks)  
 b. Design a spring used in a recoil system so as to absorb 120Nm of energy with a maximum force of 3000N. Assume spring index 8 and factor of safety is 2. [Assume  $\tau_y = 0.55\text{GPa}$  and  $G = 79\text{GPa}$ ]. (12 Marks)  
 c. Define self locking. (02 Marks)

Module-4

- 7 a. Derive an expression for beam strength of spur gear teeth. (07 Marks)  
 b. Explain dynamic tooth load. (06 Marks)  
 c. Write design procedure for wear. (07 Marks)

OR

- 8 a. Derive an expression for beam strength of helical gears. (08 Marks)  
 b. Design a pair of helical gears to transmit a power of 20KW from a shaft running at 1500rpm to a parallel shaft to be run at 450rpm. Suggest suitable surface hardness for the gear pair. (12 Marks)

Module-5

- 9 a. Define FEM? Explain advantages, limitations and applications of FEM. (06 Marks)  
 b. Explain basic steps involved in FEM. (06 Marks)  
 c. A stepped bar is subjected to loading as shown in Fig.Q9(c). Take it as a bar element. Determine :  
 i) Nodal displacement  
 ii) Stresses in each element  
 iii) Reaction at the fixed support. Take  $E = 2 \times 10^5 \text{N/mm}^2$ .

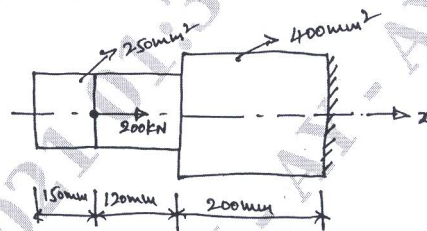


Fig.Q9(c)

(08 Marks)

OR

- 10 a. Explain with neat sketch different types of elements. (06 Marks)  
 b. Explain node numbering scheme. (06 Marks)  
 c. For the continuum as shown in Fig.Q10(c). Determine the nodal displacement, reactions at the supports. Take  $E = 200\text{GPa}$ .

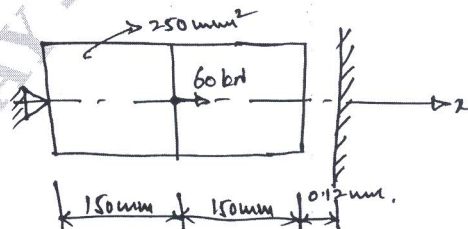


Fig.Q10(c)

(08 Marks)

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