5E1721

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B.Tech. V-Sem. (Main&Back) Examination, November/December - 2025

Automobile Engineering

5AE4-04 Design of Machine Elements - I

AE, ME

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

Attempt all Ten questions from Part A, Five questions out of seven questions from Part B and Three questions out of five questions from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205).

PART - A

(Answer should be given up to 25 words only)

All questions are compulsory. **(10×2=20)**

1. Briefly explain the principle of design for assembly.
2. Explain the endurance strength of material.
3. List the causes of stress concentration in a component.
4. State the scope of the course, design of machine elements.
5. What is the critical speed of shaft?
6. What is meant by bolts of uniform strength?
7. What do you mean by factor of safety?
8. Write the expression of stresses induced in 'Kennedy key'.
9. Write the objective of course "Design of Machine Elements".
10. Write the advantages of cast iron as an engineering material.

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PART - B

(Analytical / Problem Solving Questions)

Attempt any Five questions. **(5×4=20)**

1. How is a cotter joint made? Discuss the applications of a cotter joint.
2. A solid shaft is transmitting 1 MW at 260 rpm. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 70 MPa.
3. What is self-locking of the power screw? What is the condition for self-locking?
4. What is stress concentration? How is it mitigated?
5. A rigid coupling is used to transmit 20 kW power at 710 r.p.m. There are four bolts, and the pitch circle diameter of the bolts is 120 mm. The bolts are made of steel 45C8 (Syt = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts.
6. What are the preferred numbers? Discuss its uses.
7. Design a crane hook with the useful load lifting capacity of the crane as 50 kN. The weight of the hook with grabbing tongs is 10 kN.

PART - C

(Descriptive / Analytical / Problem Solving / Design Questions)

Attempt any Three questions. **(3×10=30)**

1. Write a short note on:
   a) Ergonomics
   b) Allowable stress
   c) Stiffness of spring
   d) Beam column.
2. Design a gib and cotter joint to resist safely a tensile load of 40 kN. The material of the gib, cotter and rods is same for which the allowable safe stresses are:
   $\sigma c = 60$ N/mm^2
   $\sigma t = 25$ N/mm^2
   $\sigma s = 20$ N/mm^2
3. Design a crank hook with the useful load lifting capacity of the crane as 50 kN. The weight of the hook with grabbing tongs is 10 kN.
4. a) Write a note on 'Design for Assembly'. **(4)**
   b) Manufacturing consideration is an important material selection criterion. Explain. **(3)**
   c) The surface roughness is limited by the manufacturing method used. Explain. **(3)**
5. Two shafts 100 mm diameter are to be connected by means of two cast iron couplings. The allowable shearing stress of the bolt material is 45 N/mm^2. While that of the shaft material is 55 N/mm^2. Find the size of the bolts to be used. Check the flange for the induced crushing stress. Is it safe for stress?

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