CBCS SCHEME

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18MT52

Fifth Semester B.E. Degree Examination, June/July 2025
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

1 a. What is machine design? And discuss its classification. **(05 Marks)**

b. Explain codes and standards. List any four organizations who have established specifications for standard and codes. **(05 Marks)**

c. A machine member 60 mm diameter is subjected to a combined loading as shown in Fig Q1(c). Determine the maximum principal stress and maximum shear stress out point P.

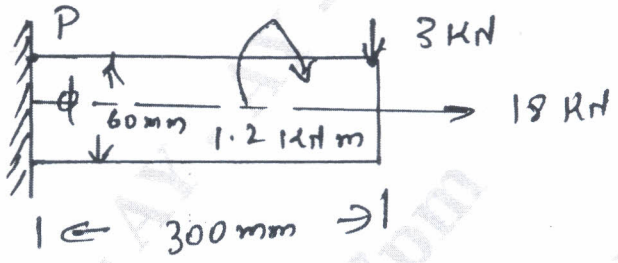

Fig Q1(c) **(10 Marks)**

OR

2 a. Explain the reasons for stress concentration in machine members and the methods adopted to relieve the same. **(05 Marks)**

b. A point in a structural member subjected to plane stress is shown in Fig Q2(b). Determine the following :

i) Principal stresses and principal planes
ii) Maximum shear stress and the direction of the planes on which it occurs
iii) Verify the answer by Mohr's circle method

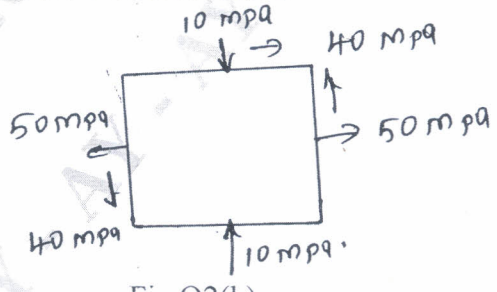

Fig Q2(b) **(15 Marks)**

Module-2

3 a. Derive an expression for impact stress in a axial bar of cross section 'A' and length 'L' due to impact of a load 'W' falling from a height 'h'. **(10 Marks)**

b. A flat bar as shown in Fig Q3(b) is subjected to an axial pull of 100 KN. Calculate its thickness if allowable tensile stress is 180 MPa.

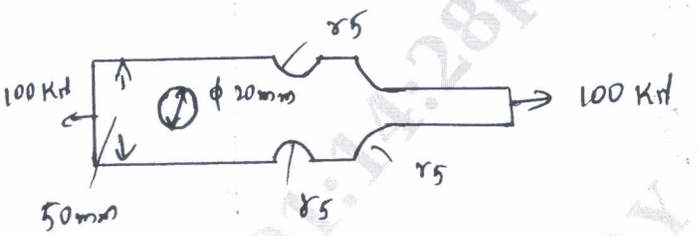

Fig Q3(b) **(10 Marks)**

OR

4 a. Explain the terms fatigue, fatigue failure and endurance strength. **(06 Marks)**

b. A steel shaft is subjected to a bending moment varies dram 100 N-m to 200 N-m and transmits 10 KW at 150 rpm. The torque varies over a range of ±40%. The shaft is made of steel where yield stress is 400 MPa and endurance stress is 300 MPa. Surface coefficient factor is 0.9 size factor is 1.2. FOS is 5. SCF is 1.94. Determine the diameter'd' based on Soderberg criterion. **(14 Marks)**

Module-3

5 a. Obtain an expression for torque required to raise the load in power screws. **(10 Marks)**

b. The jaws of a machine vice weigh 5000 N and are slided by a two start acme thread, 50 mm diameter and 8 mm pitch at a speed of 800 mm/min. The ends of the screw carried a thrust washer of mean diameter 56 mm. The coefficient of thread friction is 0.14. Determine the power of the motor required in 'KW' and the efficiency of the drive. Take $\mu_c = 0.147$.
(10 Marks)

OR

6 a. One helical spring is nested inside another, dimensions are as tabulated. Both spring has same free length and carry load of 2500 N.

	Outer spring	Inner spring
No. of coils	6	10
Wire dia	12.5 mm	9 mm
Mean coil dia	100 mm	70 mm

Determine :
i) Maximum load carried by spring
ii) Total deflection of each spring
iii) Max stress in 2 springs.
Take G = 83 GN/m^2. **(12 Marks)**

b. A truck spring has 12 numbers of levers, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 N/mm^2. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. E = 0.26 × 10^6 MPa. **(08 Marks)**

Module-4

7 A pair of spur gear with 20° full depth transmits 20 KW at 1500 rpm to pinion. Speed reduction ratio is 4. Allowable static stress of pinion is 220 N/mm^2 and gear is 193.2 N/mm^2. Check for dynamic and wear load. **(20 Marks)**

OR

8 A pair of carefully cut (class – II) helical gear for a turbine has a transmission ratio of 10 : 1, the teeth are 20° stub involute in the normal plane. Pinion has 25 teeth and rotates at 5000 rpm. Material for pinion and gear is 0.4%, Carbon steel untreated. Determine the module in normal plane, diameteral plane and face width of the gears. Suggest suitable hardness. Modulus of elasticity may be taken as 210 GPa. Helix angle = 30°, Power transmitted = 90 KW. **(20 Marks)**

Module-5

9 a. What is FEM? Explain the stress involved in the Finite element method. **(10 Marks)**

b. Explain in details the various factors to be considered in the discretization process in FEM. **(10 Marks)**

OR

10 a. Derive the stiffness matrix for bar element. **(08 Marks)**

b. A compound bar is subjected to a load 50 KN as shown Fig Q10(b). Determine the following : i) Nodal displacement ii) Stresses in each element.

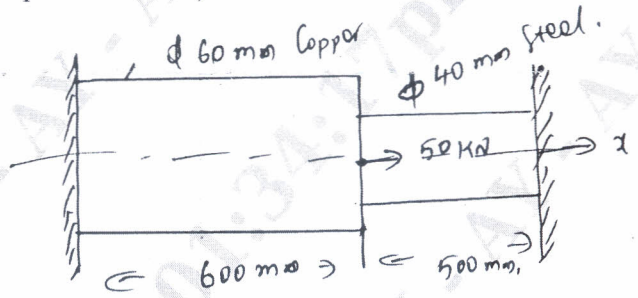

Fig Q10(b)

$E_s = 2 \times 10^5$ MPa, $E_c = 100 \times 10^3$ MPa **(12 Marks)**

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