Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

Term Evaluation (Even) Semester Examination March 2025

Roll no...............................

Name of the Course: B.Tech
Semester: Sixth
Name of the Paper: Design of Machine Elements-II
Paper Code: TME602
Time: 1.5 hour   **Maximum Marks: 50**

Note:
  (i) Answer all the questions by choosing any one of the sub-questions
  (ii) Each question carries 10 marks.

Q1.   (10 Marks)

a. Define a spring and explain its fundamental role in mechanical systems. What is the essential material properties required for manufacturing helical springs, and how do these properties influence their performance?   **CO-1**

OR

b. A helical compression spring is subjected to a fluctuating load ranging from 400 N to 1000 N. The spring has a spring index (C) of 6 and a factor of safety (Fs) of 1.25. The yield strength in shear (τys) is 770 MPa, and the endurance strength in shear (τe) is 350 MPa. Given that the maximum compression of the spring under peak load is 30 mm and the modulus of rigidity (G) is 80 kN/mm², determine the following design parameters:
(i) Wire diameter (d)
(ii) Mean coil diameter (D)
(iii) Outer and inner coil diameters (Do and Di)
(iv) Number of active coils (n)

                                                                    CO-1

Q2.   (10 Marks)

a. Explain the construction and working principle of a leaf spring. Derive the expression for bending stress in a leaf spring and discuss the conditions for achieving equalized stress distribution.
                                                                    CO-1

OR

b. Derive the expression for the maximum shear stress in a helical compression spring subjected to an axial load. Also, discuss the effect of Wahl's correction factor in stress calculations.
                                                                    CO-1

Q3.   (10 Marks)

a. Derive the expression for energy stored in a helical coil spring and explain how it varies with different spring parameters.   **CO-1**

OR

b. A helical compression spring used in a cam mechanism is subjected to an initial preload of 80 N, with a maximum operating force of 200 N during the load cycle. The spring has a wire diameter of 4 mm and a mean coil diameter of 22 mm. It is made of oil-hardened and tempered valve spring wire of Grade-VW with an ultimate tensile strength (*Sut*) of 1500 N/mm². Determine the following:
(i)   Factor of safety based on fluctuating stresses.
(ii) Number of active coils required for the given load conditions.   **CO-1**

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Q4. (10 Marks)

a. Explain the different types of belts used in mechanical power transmission systems. Compare flat belts and V-belts in terms of construction, working principle, and applications. **CO-2**

OR

b. A cross belt drive system consists of two pulleys with diameters of 450 mm and 200 mm, mounted on parallel shafts that are 1.95 m apart. Determine the following:
(i)Total length of the belt
(ii)Angle of lap on both pulleys
(iii)Power transmitted when the larger pulley rotates at 2000 rpm
(iv)Tension ratio, assuming a coefficient of friction $\mu = 0.25$ **CO-2**

Q5. (10 Marks)

a. Derive an expression for the length of an open flat belt drive. Explain how belt length varies with the center distance between pulleys. **CO-2**

OR

b. What is slip and creep in belt drives? Explain their causes, effects, and how they can be minimized in flat belt systems.
CO-2