N/mm^2 .The solid length of the spring is 50mm. Find the diameter of coil, diameter of wire and number of coils .C = 4.5 xl04N/mm^2.

10. A closely coiled helical spring of round steel wire 10 mm in diameter having 10 complete turns with a mean diameter of 12 cm is subjected to an axial load of 250 N. Determine
    I. the deflection of the spring
    II. maximum shear stress in the wire and
    III. stiffness of the spring and
    IV. frequency of vibration. Take C = 0.8 x 10^5 N/mm^2 .

UNIT IV
DEFLECTION OF BEAMS
PART-A (2 Marks)

1. State the condition for the use of Macaulay's method.
2. What is the maximum deflection in a simply supported beam subjected to uniformly distributed load over the entire span?
3. What is crippling load? Give the effective length of columns when both ends hinged and when both ends fixed.
4. Find the critical load of an Euler's column having 4 m length, 50 mm x 100 mm cross section and hinged at both the ends E = 200 kn/mm2.
5. Calculate the maximum deflection of a simply supported beam carrying a point load of 100 KN at mid span. Span = 6 m, E= 20000 kn/m2.
6. A cantilever beam of spring 2 m is carrying a point load of 20 kn at its free end. Calculate the slope at the free end. Assume EI = 12 x 10^3 KNm^2.
7. Calculate the effective length of a long column, whose actual length is 4 m when : a. Both ends are fixed b. One end fixed while the other end is free.
8. A cantilever is subjected to a point load W at the free end. What is the slope and deflection at the free end?
9. What are the methods for finding out the slope and deflection at a section?
10. Why moment area method is more useful, when compared with double integration?
11. Explain the Theorem for conjugate beam method?
12. What are the points to be worth for conjugate beam method**?**
13. What are the different modes of failures of a column?
14. Write down the Rankine formula for columns.
15. What is effective or equivalent length of column?
16. Define Slenderness Ratio.
17. Define the terms column and strut.
18. What are the advantages of Macaulay method over the double integration method, for finding the slope and deflections of beams?
19. State the limitations of Euler's formula
20. A cantilever beam of spring 4 m is carrying a point load of $2x10^3$Nat its free end. Calculate the slope at the free end. Assume EI = $2X10^5$ N/mm^2

PART-B (16 Marks)

1. A beam AB of length 8 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs. Take E = 2 x 10^5 N/mm^2 and I = 8.5 $X10^6$ mm^4 .

2. A 1.2 m long column has a circular cross section of 45 mm diameter one of the ends of the column is fixed in direction and position and other ends is free. Taking factor of safety as 3, calculate the safe load using

(i) Rankine's formula, take yield stress = 560 N/mm^2 and a = 1/1600 for pinned ends.
(ii) Euler's formula, Young's modulus for cast iron = 1.2 x 105 N/mm^2.

3. For the cantilever beam shown in Fig.3. Find the deflection and slope at the free end. EI = 10000 kN/m^2.

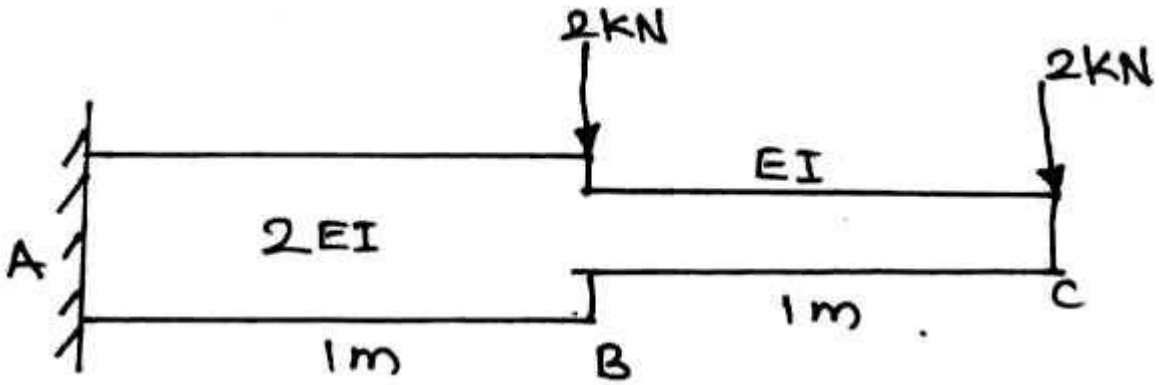

Fig.3

4.A beam is simply supported at its ends over a span of 10 m and carries two concentrated loads of 100 kN and 60 kN at a distance of 2 m and 5 m respectively from the left support. Calculate
(i) slope at the left support (ii)slope and deflection under the 100 kN load. Assume EI = 36 x 104 kN-m^2.

5. Find the Euler critical load for a hollow cylindrical cast iron column 150 mm external diameter, 20 mm wall thickness if it is 6 m long with hinged at both ends. Assume Young's modulus of cast iron as 80 kN/mm2. Compare this load with that given by Rankine formula. Using Rankine constants a =1/1600 and 567 N/mm^2.

6.A 3 m long cantilever of uniform rectangular cross–section 150 mm wide and 300 mm deep is loaded with a point load of 3 kN at the free end and a udl of 2 kN/m over the entire length. Find the maximum deflection. E = 210 kN/mm2. Use Macaulay's method.

7. A simply supported beam of span 6 m is subjected to a udl of 2 kN/m over the entire span and a point load of 3 kN at 4 m from the left support. Find the deflection under the point load in terms of EI. Use strain energy method.

8.A simply supported beam of uniform flexural rigidity EI and span l, carries two symmetrically placed loads P at one–third of the span from each end. Find the slope at the supports and the deflection at mid–span. Use moment area theorems.

9. Derive double integration method for cantilever beam concentrated load at free end.

10. Determine the section of a hollow C.I. cylindrical column 5 m long with ends firmly built in. The column has to carry an axial compressive load of 588.6 KN. The internal diameter of the column is 0.75 times the external diameter. Use Rankine's constants. a = 1 / 1600, σ_c = 57.58 KN/cm^2 and F.O.S = 6.