MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

STRENGTH OF MATERIALS

DATE: 4/8/2016 **TIME: 2:00 – 4:30 AM**

INSTRUCTIONS:

Attempt all questions

1. a) A close-coiled helical spring of mean diameter D is subjected to an axial load W. If the number of coils and wire diameter are n and d respectively, show from first principles that the spring rate S is given by:-

$$S = \frac{Gd^4}{8nD^3}$$ (10 marks)

b) A close-coiled helical spring has to absorb 50 joules of energy when compressed 50mm. The coil diameter is eight times the wire diameter. If there are ten coils, estimate the diameters of coil and wire and the maximum shear stress G = 85,000N/mm^2. (10 marks)

2. a) Show that angular rotation θ for an open-coiled helical spring loaded with axial load is given by

$$\theta = 2\pi nWR^2 \sin \propto \left[\frac{1}{GJ} - \frac{1}{EI}\right]$$

Where n – number of turns of the coil
W – Load
R – Radius of the coil
α - Helix angle of the coil
G – Modulus of rigidity
J – Polar second moment of area
E – Modulus of elasticity
I – second moment of area (10 marks)

b) An open-coiled helical spring is made having 10 turns wound to a diameter of 120mm. The wire diameter is 10mm and the coils make an angle of 30^0 with a plane perpendicular to the axis of the coil. Find:-

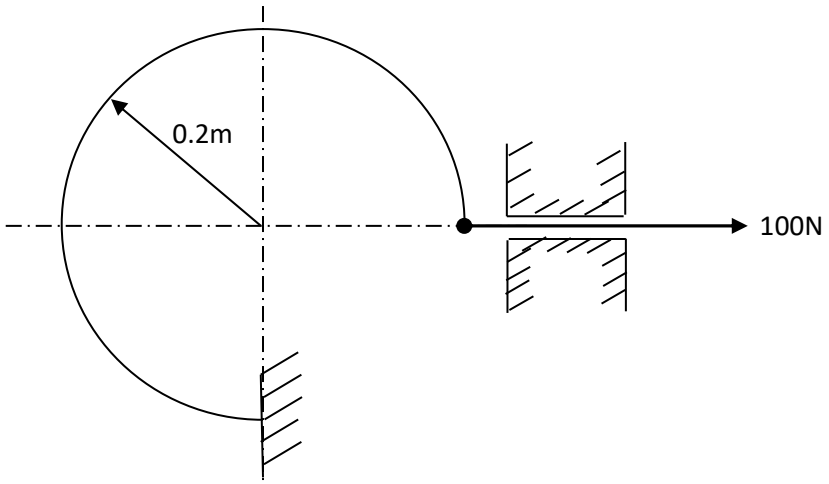
i. The axial extension with a load of 100N

ii. The angle the free end will turn with this load if free to rotate.

$E = 208{,}000N/mm^2$; $G = 83{,}000N/mm^2$. (10 marks)

3. A steel rod, 10mm diameter, is bent into the shape below. One end being rigidly clamped, the other being constrained to move in a horizontal slide. Determine the horizontal deflection of the slider when acted upon by a force of 100N. $E = 200GN/m^2$

(20 marks)



4. The figure below shows a cantilever ABC, lying in a vertical plane. The cantilever is made from a uniform circular bar. The quantrant AB is of radius *r* and the straight portion BC is of length *l*. A vertical load *W* is applied at the free end. Derive the expression for the vertical deflection at the loaded end. (20 marks)