UNIVERSITY OF GHANA

BSc. ENGINEERING FIRST SEMESTER EXAMINATIONS: 2016/2017
SCHOOL OF ENGINEERING SCIENCES
FAEN 203: STRENGTH OF MATERIALS (3 CREDITS)

INSTRUCTIONS:
ANSWER ALL QUESTIONS
TIME ALLOWED: TWO (2) HOURS

1. (a) Differentiate between the following:
   (i) Flexibility and Ductility.
   (ii) Yield strength and Ultimate strength.

   (b) (i) Outline two importance each of flexibility and ductility in engineering design.
   (ii) Elaborate on three factors that can affect the yield strength of a material.
   [13 marks]

2. (a) Determine the maximum deflection, y in the simply supported beam in Figure 1 of span length, L carrying a concentrated load, P at mid-span. [Hint: Use double integration method]. [20 marks]

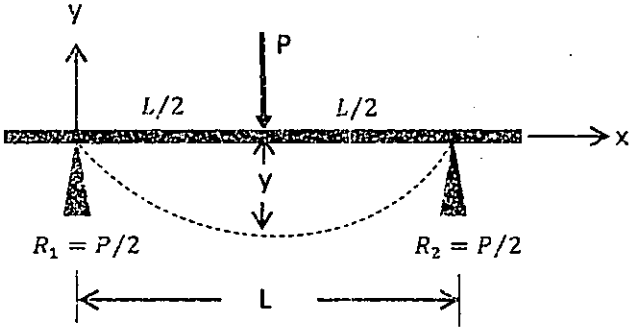

Figure 1: A beam undergoing bending under applied load, P.

(b) Table 1 are values of load and deflection obtained from a steel strip (length = 0.15 m, width = 0.01 m and height = 0.001 m) that underwent bending similar to that illustrated in Figure 1. Determine the Young's modulus of the strip by using the values in table 1. [15 marks]

Table 1. Load and Deflection values for a steel strip during bending

Load / kg	Deflection, y / 10^{-3} m
0.00	0.0
0.05	3.0
0.10	6.5
0.15	9.0
0.20	13.0
0.25	16.0

3. (a) A vertical load, P = 2100 N is supported by two inclined steel wires AC and BC as shown in Figure 2. Determine the required cross-sectional area, A of each wire if the allowable working stress in tension is 700 Nm^{-2}. Given, $\theta = 30°$, $E = 2.0 * 10^6$ Pa and AB = 10 m. Also calculate the vertical deflection of the point C. [15 marks]

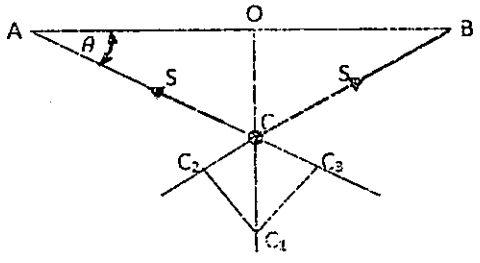

Figure 2: A vertical load supported by two inclined steel wires AC and BC.

(b) A solid shaft 6 m long is subjected to a torque of 12 kNm, if the angle of twist is 3° and rigidity modulus, G is 83 GPa. Calculate the minimum diameter of the shaft. [10 marks]

4. (a) Show that the strain energy density, U of a ductile material under tensile principal stresses, σ_1, σ_2 *and* σ_3 is given by

$$U = \frac{1}{2E}[\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2v(\sigma_1\sigma_2 + \sigma_2\sigma_3 + \sigma_3\sigma_1)] \quad [10 \text{ marks}]$$