Menoufiya University Faculty of Engineering Shebin El-Kom Final First-Term Exam. Total Marks: **85 Marks**		Year: First Year Department: Production Eng. Subject: PRE 111, Properties of materials Time Alloyed: 3 hours Date: 24 / 1 / 2019

Answer all the following Questions

Question (1) **(15 Marks)**

a) Choose the correct answer:

1. The unit stress in S.I. units is
   (a) MN/m^2 (b) kN/mm^2 (c) N/mm^2 (d) all of the above
2. There is always a limiting value of load upto which the strain totally disappears on the removal of load; the stress corresponding to this load is called
   (a) yield stress (b) elastic limit (c) direct stress (d) none of the above
3. Strain in direction at right angles to the direction of applied force is known as
   (a) shear strain (b) direct strain (c) volumetric strain (d) lateral strain
4. Temperature stress developed in a bar depends upon which of the following?
   (a) change of temperature (b) Young's modulus
   (c) coefficient of linear expansion (d) all of the above
5. When a tensile or compressive force (P) acts on a body, the change in its length is given by (a) $\frac{\sigma}{\varepsilon}$ (b) $\frac{PL}{E}$ (c) $\frac{\sigma L}{E}$ (d) $\frac{PE}{LA}$

b) A railway line is laid so that there is no stress in the rails at 60°C. Calculate the stress in the rails at 20°C if there is an allowance of 5 mm for contraction per rail and the rails are 30 m long. (Take E = 210 GN/m^2, $\alpha = 0.000012$ per °C.

c) A reinforced concrete column is 300 mm in diameter and has 4 steel bars each of 12 mm diameter embedded in it is subjected to a weight of 300 kN. If the modulus of elasticity for steel is 15 times that for concrete, find the stresses in the steel and the concrete. Also, if the stress in the concrete must not exceed 4 MN/m^2, what area of steel is required in order that the column may support a load of 500 kN?

Question (2) **(15 Marks)**

a) Define the following terms:
Ductility, Malleability, The 0.2% offset yield stress, Hardness of metals indicating two methods for measuring it.

b) Define the elastic constants: E, G, K and Poisson's ratio and write the relationship between them.

c) A bar of metal 100 mm × 80 mm in cross-section is 250 mm long. It carries a tensile load of 480 kN in the direction of its length, a compressive load of 1000 kN on its 100×250 mm faces and a tensile load of 900 kN on its 80×250 mm faces. If E = 200 GN/m^2 and Poisson's ratio is 0.25. Determine the change of volume of the bar and what change must be made in the 1000 kN load in order that there shall be no change in volume of the bar.

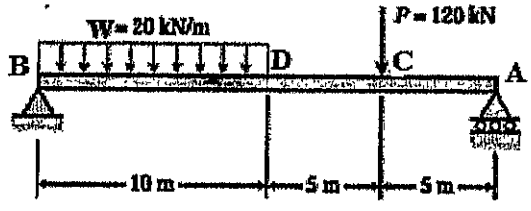
b) Obtain the equation of the deflection curve for the simple beam AB (see figure). Also, determine:

i) the angle of rotation (slope) at the right-hand support A ,

ii) the deflection at point C.

iii) The maximum deflection.

(For the beam, assume E = 200 GPa and I = 2.60 $\times 10^9$ mm^4.)



This exam contributes by measuring the achieving Programme Academic Standards according to NARS

Question Number	Q1-a, b	Q2-a, b	Q3-a, b	Q4-a	Q5-a	Q1-c	Q2-c	Q3- c	Q4-b	Q5-b	Q1	Q4	Q5	
Skills	a3-1	a3-1	a4-1	a3-1	a3-1	b5-1	b5-1	B5-1	b17-1	b17-1		c2	c3	
	Knowledge & Understanding Skills					Intellectual Skills					Professional Skills			

With our best wishes

Dr. Salah Abdelwahab Assela

Dr. Badr Mohamad Abdelbary

3. An eccentric load W, with eccentricity e, is equivalent to
   a) an axial load W b) a moment equal to $W \times e$
   c) both (a) and (b) d) none of the above
4. In a rectangular section the stress will be of the same sign throughout the section if the load lies within the ..... of the section
   a) middle third b) middle half
   c) either of all above d) none of the above
5. In case of a circular section the maximum shear stress
   a) $q_{max} = \frac{1}{2}\frac{Q}{A}$ b) $q_{max} = \frac{4}{3}\frac{Q}{A}$ c) $q_{max} = \frac{3}{2}\frac{Q}{A}$ d) $q_{max} = \frac{5}{2}\frac{Q}{A}$

b) Compare between the direct stress and the bending stress.

c) A load of 75 kN is carried by column made of cast iron. The external and internal diameters are 200 mm and 180 mm respectively. If the eccentricity of the load is 35 mm. Determine:
   i) The maximum and minimum stress intensities.
   ii) Upto what eccentricity there is no tensile stress in the column.

Question (5) **(20 Marks)**

a) Choose the correct answer:

1. The amount of deflection of a beam subjected to some type of loading depends upon
   a) cross-section b) bending moment c) either a) or b) d) both a) and b).
2. The deflection at the free end of a cantilever of length l carrying a point load W at its free and is given as:
   a) $\frac{WL}{2EI}$ b) $\frac{WL^2}{2EI}$ c) $\frac{WL^3}{3EI}$ d) $\frac{WL^4}{8EI}$
3. A simply supported beam of span L is carrying a uniformly distributed load of ω per unit length run over the whole span. The maximum deflection in this case is given as:
   a) $\frac{\omega L^4}{48EI}$ b) $\frac{\omega L^3}{384EI}$ c) $\frac{\omega L^4}{8EI}$ d) $\frac{5\omega L^4}{384EI}$
4. A cantilever of length l *is* carrying a uniformly distributed load of ω per unit length run over the whole span. The deflection at the free end is given as:
   a) $\frac{\omega L^3}{4EI}$ b) $\frac{\omega L^2}{4EI}$ c) $\frac{\omega L^4}{8EI}$ d) $\frac{\omega L^4}{16EI}$
5. A simply supported beam of span L is carrying point load W at the mid span. What is the deflection at the center of the beam?
   a) $\frac{WL^2}{48EI}$ b) $\frac{WL^3}{84EI}$ c) $\frac{WL3}{48EI}$ d) $\frac{5WL^4}{384EI}$

Question (3) **(15 Marks)**

a) Choose the correct answer:

1- The shafts are designed on the basis of
(a) strength (b) ductility (c) rigidity (d) all of the above

2- The angle of twist is ..... proportional to the twisting moment.
(a) inversely (b) directly (c) either (a) or (b) (d) none of the above

3- For the same material, length and given torque a hollow shaft weighs ..... a solid shaft.
(a) less than (b) more than (c) equal to (d) none of the above

4- The strength of a hollow shaft for the same length, material and weight is ..... a solid shaft.
(a) less than (b) more than (c) equal to (d) none of the above

5- If a close-coiled helical spring is subjected to load P and the axial deflection produced is x, then stiffness of the spring is given by
(a) $\frac{P}{x}$ (b) $P.x^2$ (c) $\frac{P}{2x}$ (d) P. x

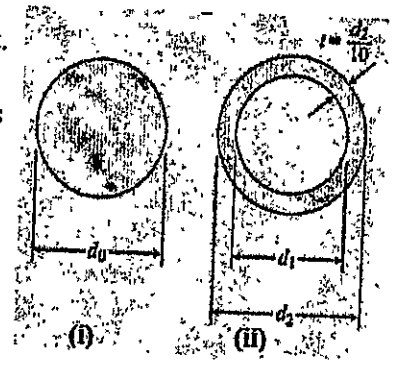
b) Derive an expression for the maximum shear stress in a close-coiled helical spring, mean coil diameter D, wire diameter d, subjected to an axial load P.

c) A steel shaft is to be manufactured either as a solid circular bar or as a circular tube. The shaft is required to transmit a torque of 1200 N.m without exceeding an allowable shear stress of 40 MPa nor an allowable rate of twist $\theta/_L$ of 0.75°/m. (The shear modulus of elasticity of the steel is 80 GPa).

(i) Determine the required diameter d_0 of the solid shaft.

(ii) Determine the required outer diameter d_2 of the hollow shaft if the thickness t of the shaft is specified as one-tenth of the outer diameter.

(iii) Determine the ratio of diameters (that is, the ratio d_2/d_0) and the ratio of weights of the hollow and solid shafts.



Question (4) **(20 Marks)**

a) Choose the correct answer:

1. In case of a circular section the section modulus is given as

a) $\frac{\pi d^2}{16}$ b) $\frac{\pi d^3}{16}$ c) $\frac{\pi d^3}{32}$ d) $\frac{\pi d^4}{64}$

2. Circular beams of uniform strength can be made by varying diameter in such a way so that

a) $\frac{M}{Z}$ is constant b) $\frac{\sigma}{y}$ is constant c) $\frac{E}{R}$ is constant d) $\frac{M}{R}$ is constant