Menoufiya University **Faculty of Engineering** *Dept. Production Engineering* Final Exam (2013-14) - 2nd Term Date: June 1, 2014	(logo) جامعة المنوفية	**Metallurgy and Engineering** **Materials** Code: PRE 222 Time: 3 hrs. Total Marks: 90 Marks

Solve the following questions:

Question no. 1 (Choose the correct answer)   **(15 marks)**

1. Metallic bonding is considered the weakest form of bonding....................... (True) or (False)
2. Body Centered Cubic (BCC) has the lowest atomic packing factor............... (True) or (False)
3. Some metals as well as nonmetals have more than one crystal structure, a phenomenon known as Amorphous. .... (True) or (False)
4. Amorphous is a phenomenon in which measured properties are independent of the direction of measurement. .... (True) or (False)
5. A sheet of polycrystalline steel produced by rolling is likely to exhibit anisotropy?..... (True) or (False)
6. Ionic bonds are formed by the transfer of one or more electrons from an electropositive atom to an electronegative one. .... (True) or (False)
7. The distance between the atoms (interatomic distance) in crystal structure can be determined experimentally by X-ray diffraction analysis.   .... (True) or (False)
8. In Covalent bonding, the outer valence electrons of the atoms are shared by many surrounding atoms, and so in general, Covalent bonding in nondirectional. .... (True) or (False)
9. Glass is considered a true solid materials because it has a noncrystalline structure...   (True) or (False)
10. Fatigue failure is a form of failure that occurs in structures subjected to dynamic and fluctuating stresses. .... (True) or (False)
11. Fatigue (endurance) limit represents the largest value of fluctuating stresses that will not cause failure for essentially an infinite number of cycles. .... (True) or (False)
12. Toughness is a measure of the ability of a material to absorb energy up to fracture. ... (True) or (False)
13. Ductility is a measure of the degree of elastic deformation that has been sustained at fracture. .... (True) or (False)
14. In stress-strain curve, deformation in which stress and strain are linearly proportional is called plastic deformation. .... (True) or (False)
15. Creep failure represents the mode of failure in which the material fails under the effect of static loading .... (True) or (False)

Question no. 2   **(15 marks)**

a) Draw the following planes and directions; (121), (021), $(\bar{1}0\bar{1})$, $[121]$, $[021]$, $[\bar{1}0\bar{1}]$
b) Drive planner density expressions for BCC (100) and (110) planes in terms of atomic radius R and compute and compare the planner density values for these same two planes for iron where, $R=0.124$ nm.
c) Aluminum is FCC, has a lattice parameter, a, of 0.4049 nm. Calculate the following interplanar spacing:

    1) d_{110} b) d_{111} c) d_{220}

Question no. 3   **(15 marks)**

a) Explain briefly the types of point defects in crystal structural?
b) Cite the differences between edge and screw dislocations?
c) Cite the difference between ductile fracture and brittle facture? Write shortly the factors that may transfer brittle fracture to ductile facture.
d) A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 10 mm. Determine the magnitude of the load required to produce a 2.5×10^{-3} mm change in diameter if the deformation is entirely elastic. Take the modulus of elasticity, $E = 97$ GPa.

(1)

Question no. 4 (15 marks)

1) Explain the meaning and the processes involved in:
   a) Work hardening
   b) Solid solution hardening
   c) Precipitation hardening
   d) Grain size hardening,
   (Quoting instances in which each method is used in engineering practice).

2) Compare between:
   - Graphite and Graphene
   - Brass and Bronze
   - Hardness and Hardenability
   - Austempering and Martempering
   - Eutectic and Eutectoid
   - White C.I and Nodular C.I
   - Carburizing and Nitriding

Question no. 5 (15 marks)

a) Calculate the critical radius (in centimeters) of a homogeneous nucleus that forms when pure liquid copper solidifies.   Assume under cooling = 0.2 (melting point).
   Calculate the number of atoms in this critical-sized nucleus at this undercooling.
   (Melting point of Cu 1083 °C, surface force energy 177×10^{-7} J/cm^2, latent heat of solidification = -1826 J/cm^3, and lattice parameter = 0.361 nm).

b) - Describe the steps for constructing TTT diagram of 1080 Steel.
   - Draw the time-temperature cooling paths for 1080 Steel on TTT that will produce the following microstructure: (Start with the Steels in the Austenitic condition at time = 0 and 880 °C.)
i) 100% M,   ii) 50%M + 50% Coarser P,   iii) 50% M + 50% upper B, and   iv) 100% lower B.

Question no. 6 (15 marks)

a) Define the following engineering materials giving an example of each as well as the appropriate application:
   - Metal
   - Alloy
   - Composite
   - Thermoset polymer
   - Superalloy
   - Shape memory alloy
   - Self-healing polymer
   - Duralumin
   - Biomaterial
   - Tempered glass

b) Platinum (Pt) melts at 1800 °C and Silver (Ag) melts at 960 °C. At 1185 °C, the following reaction takes place: $\alpha_{10\%Ag} + L_{66\%Ag} \rightleftharpoons \beta_{42\%Ag}$

At 400 °C, the solid solubility of α and β are 2% Ag and 90% Ag, respectively.
   - Draw to scale the Pt-Ag phase diagram.
   - For an alloy 40% Pt;
      - Make phase analysis at $1185 \pm \Delta T$.
      - Draw the cooling curve from 1600 °C to 400 °C.

c) A 0.9% C steel is slowly cooled from 900 °C to a temperature just slightly below 723 °C.
      - Calculate wt.% proeutectoid Cementite.
      - Calculate wt.% eutectoid Cementite.

d) In April 1912, the Royal Mail Ship "Titanic" struck an iceberg while steaming at 20 t knots and sank off Newfoundland in less than 3 hrs with a loss of over 1500 people.
- What, in your opinion and from an engineering point of view, are the several reasons for this catastrophic failure?

========================= GOOD LOOK =========================

This exam measures the following ILOs								
Question Number	Q1,Q6-a	Q4,Q3-a,b,c	Q2, Q6-d	Q3-d, Q6-d	Q6	Q5	Q3-d, Q5-b	These skills are measured else where	
Skills	a3-1	a19-1	b3-1	b6-1	b13-1	c1-1	c17-1	d1-1	d9-1
Knowledge &Understanding		Intellectual Skills				Professional Skills		General skills	