UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	BDA 10803
PROGRAMME	:	BDD
EXAMINATION DATE	:	DECEMBER 2018/ JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	**SECTION A IS COMPULSORY** **SECTION B** – ANSWER **4 (FOUR)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 (a) List TWO (2) types of forming methods for ceramic with its raw materials form.

(2 marks)

(b) Identify THREE (3) classifications of low alloy steel with brief explanation.

(6 marks)

(c) Illustrate FOUR (4) steps in uniaxial powder pressing.

(8 marks)

(d) Compare between ferrous and non-ferrous metals.

(4 marks)

SECTION B

Q2 (a) Define the meaning of monomer and polymer. Give **ONE (1)** example of each.

(2 marks)

(b) Refer to **Figure Q2(b i-iv)**, identify all the direction and plane.

(6 marks)

(c) Calculate:

(i) the percentage of unit cell space compacted with atoms in the simple cubic structure (SCC)

(6 marks)

(ii) the radius of sphere atom that filled in simple cubic structure (SCC) if the lattice parameter is 0.361 nm.

(2 marks)

(d) Compare the main differences of injection moulding over blow molding.

(4 marks)

Q3 (a) Give the schematic atomic structure of Based Centered Cubic (BCC) for γ-iron.

(2 marks)

(b) Given an epoxy/carbon unidirectional continuous fiber composite with $V_f = 0.60$ and the following fiber and matrix properties:

	Ultimate Strength, σ (MPa)	Modulus, E (GPa)
Epoxy	57.9	3.8
Carbon fibers	2400	399.9

Identify the transverse stiffness modulus of the composite.

(6 marks)

(c) Determine the linear atomic density, ρ_l of the [101] for the given structure and lattice constant,a of iron structure below:

(i) FCC, a= 0.287nm

(4 marks)

(ii) BCC, a=0.362nm

(4 marks)

(d) Differentiate between iso-stress and iso-strain by using suitable diagram with explanation.

(4 marks)

Q4 (a) Define an interstitial solid solution.

(2 marks)

(b) Explain all three stages of creep by using a typical creep curve of strain versus time at constant stress and constant elevated temperature.

(6 marks)

(c) If boron is diffused into a thick slice of silicon with no previous boron in it at a temperature of 1100°C for 5 h, what is the depth below the surface at which the concentration is 10^{17} atoms/cm^3 if the surface concentration is 10^{18} atoms/cm^3? Given, D = 4 x 10^{-13} cm^2/s for boron diffusing in silicon at 1100°C. Table 4(c) is the tabulation of error function value.

(8 marks)

Table 4 (c): Tabulation of Error Function Values

z	*erf(z)*	*z*	*erf(z)*	*z*	*erf(z)*
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9253
0.5	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

(d) According to stress-strain behaviour of metal, it can display an elastic or plastic deformation. Differentiate between elastic and plastic deformation.

(4 marks)

Q5 (a) Name and define **ONE (1)** type of line in phase diagram.

(2 Marks)

(b) Explain the importance of phase equilibrium in application.

(6 Marks)

(c) By interpreting phase diagram of Pb-Sn (Refer **Figure Q5 (c)**), Solve phase analysis for composition of 30% Sn at 183°C + ΔT and 30% Sn at 183°C - ΔT by find:

(i) Interpret each phase composition for 30% Sn at 183°C + ΔT and 30% Sn at 183°C -ΔT.

(4 marks)

(ii) Find amount of weight proportion for each fraction for 30% Sn at 183°C + ΔT and 30% Sn at 183°C - ΔT.

(4 marks)

(d) Differentiate the eutectic and eutectoid three-phase invariant reaction in binary phase diagram in terms of their equation and phase diagram characteristic.

(4 Marks)

Q6 (a) Define martensite microstructure.

(2 marks)

(b) Explain briefly THREE (3) of the following process:

(i) tempering process
(ii) cold work process
(iii) recovery process
(iv) recrystallization process

(6 marks)

(c) **Figure Q6 (c)** shows TTT diagram for a Fe - 0.6 wt.% C steel alloy. Sketch and label on this diagram the expected cooling rate if the steel is subjected to the following process:

(i) annealing
(ii) normalizing
(iii) oil-quenched
(iv) water-quenched

(8 marks)

(d) Differentiate the phases present (i, ii, iii and iv) in Fe-Fe_3C phase diagram as shown in **Figure Q6 (d).**

(4 marks)

-END OF QUESTION-

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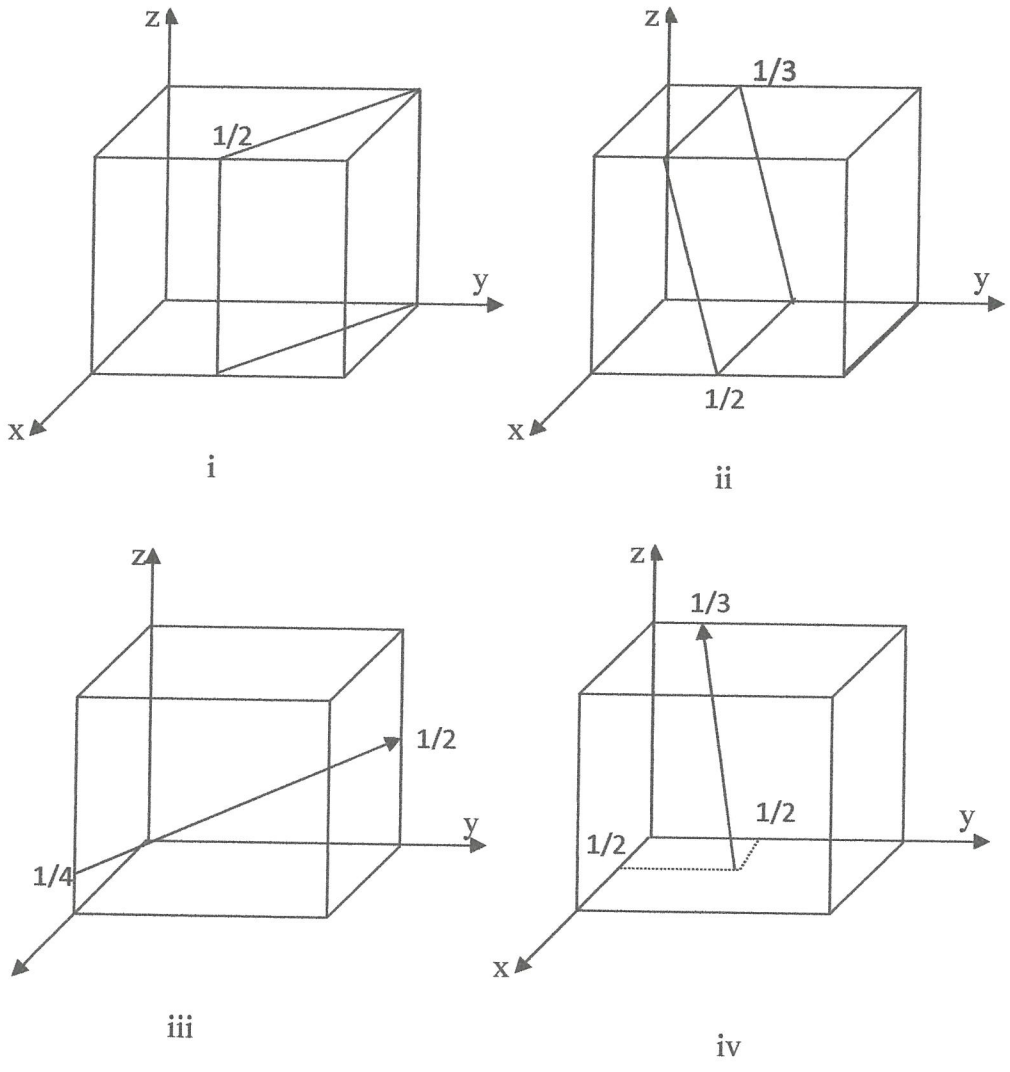

Figure Q2 (b i-iv)

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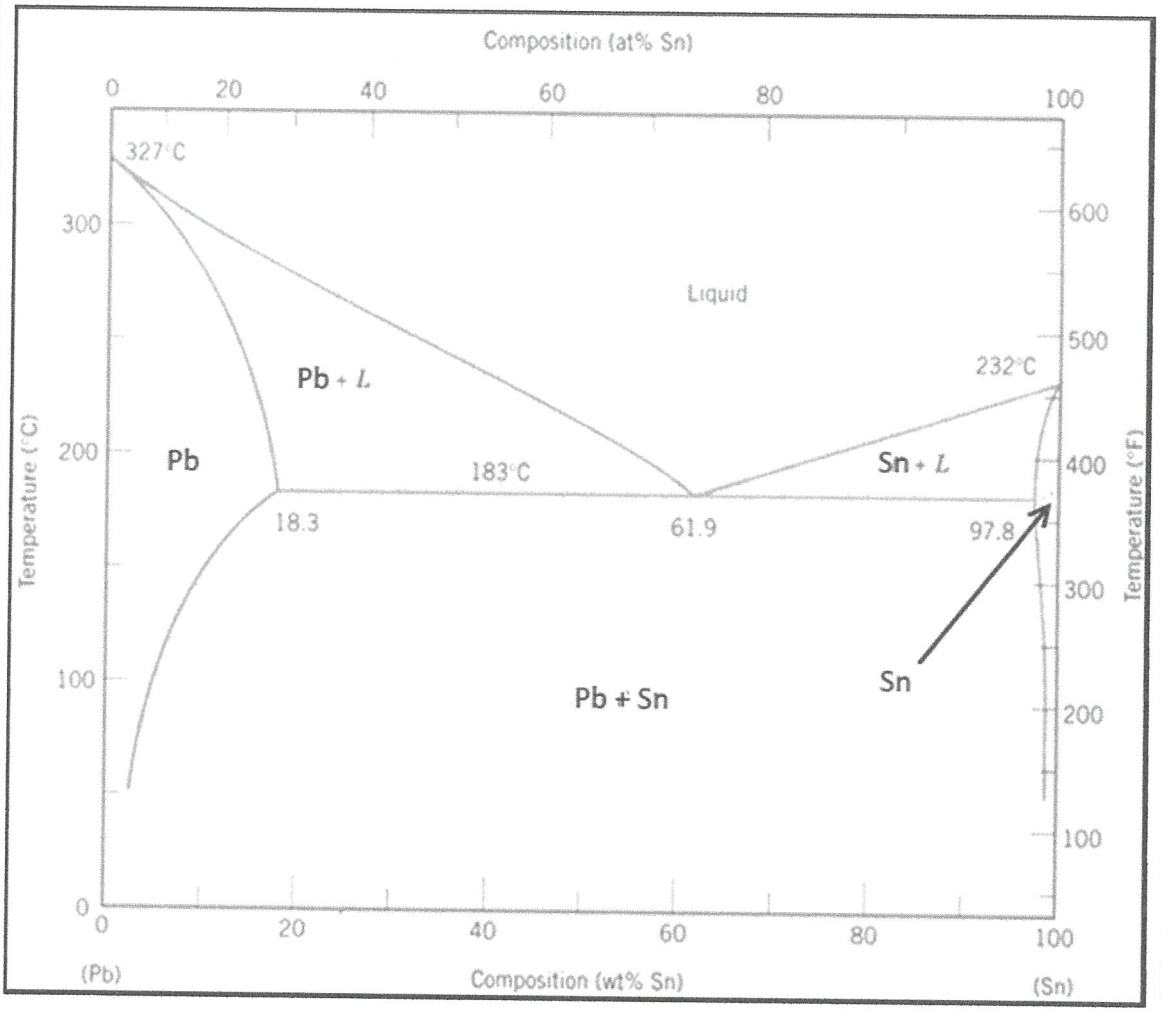

Figure Q5 (c)

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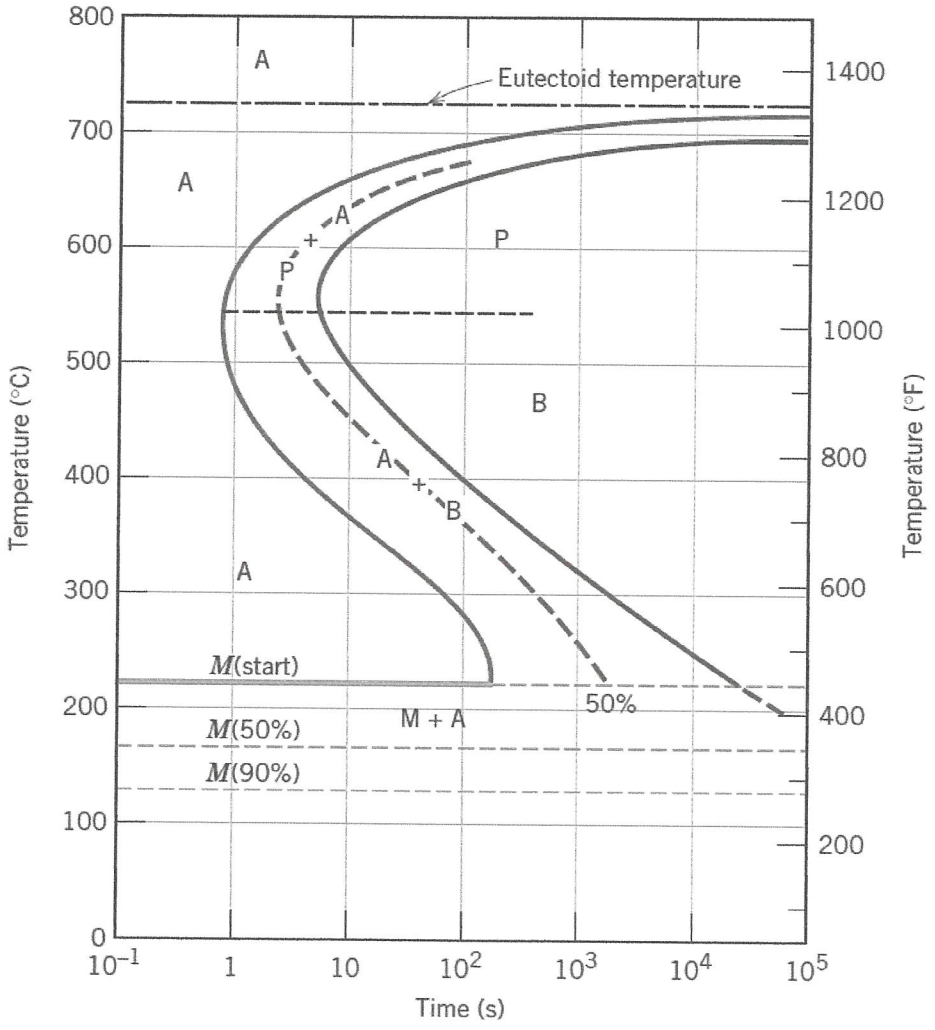

Figure Q6 (c)

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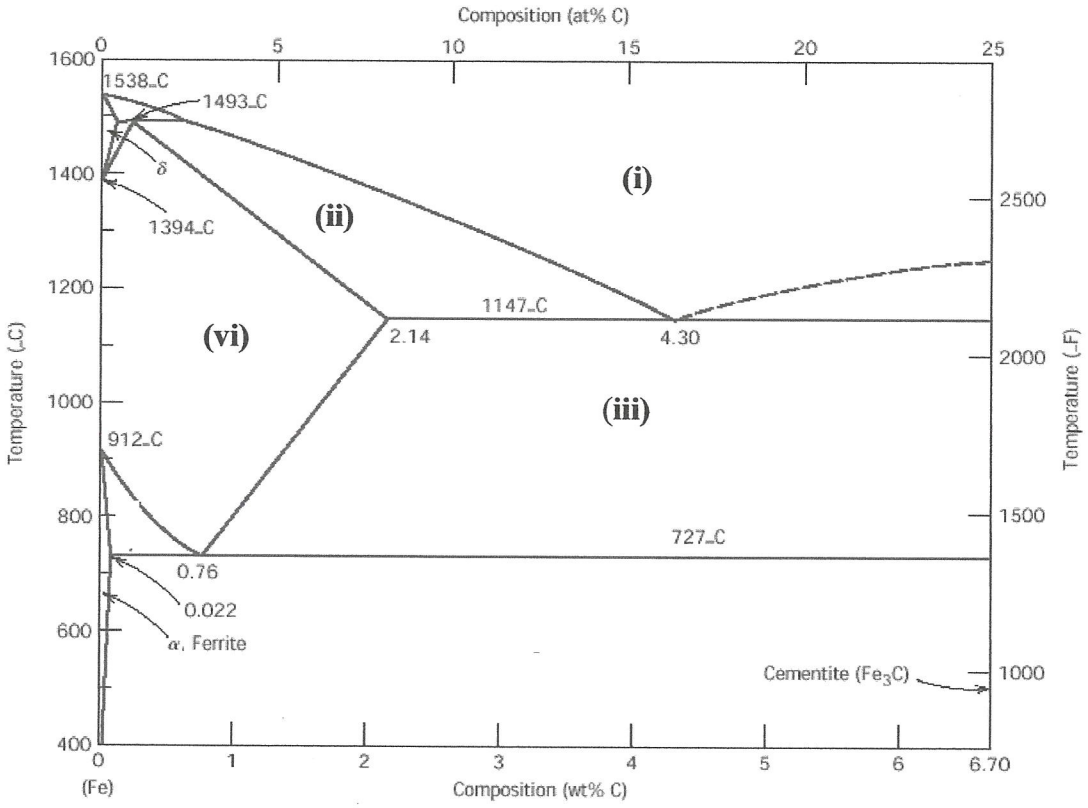

Figure Q6 (d)