Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION

SEMESTER I

SESSION 2016/2017

COURSE NAME	:	ENGINEERING TECHNOLOGY MATERIALS
COURSE CODE	:	BDU 10603
PROGRAMME	:	1 BDC/1 BDM
EXAMINATION DATE	:	DECEMBER 2016/JANUARI 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER FIVE (5) OF SIX (6) QUESTIONS

THIS QUESTION PAPER CONSISTS OF EIGHT **(8)** PAGES

Q1 (a) Define the following terms:

(i) Ductility

(ii) Creep

(iii) Hardness

(iv) Fatigue

(4 marks)

(b) In cubic unit cells, sketch the following direction vectors and crystal planes.

(i) $[2\bar{3}3]$

(ii) $\overline{[02(1])}$

(iii) $(1\,\bar{1}\,\bar{1})$

(iv) $(10\bar{3})$

(8 marks)

(c) Calculate the value of atomic mass for BCC tantalum at 20°C, given that the lattice constant is 0.33026 nm and its density is 16.6g/cm^3.

(8 marks)

Q2 (a) List out four (4) types of point defects occurs for 0D defects.

(4 marks)

(b) Aluminum is diffused into a thick slice of silicon at a temperature of 1100°C for 6 h. The given value of the diffusion,D during the process is 2×10^{-12} cm^2/s. Determine the depth below the surface at which the concentration is 10^{16} atoms/cm^3 while the surface concentration is 10^{18} atoms/cm^3. The Error Function value is given in Table **Q2(b)**.

(6 marks)

(c) Explain the effect of temperature on diffusions by providing related mathematical equation.

(4 marks)

(d) The diffusivity of manganese atoms in the FCC iron lattice is 1.5×10^{-14} m^2/s at 1300°C and 1.5×10^{-15} m^2/s at 400°C. By applying the concept of temperature influenced diffusivity $= D_0 \exp\left(-\frac{Q_d}{RT}\right)$, determine the activation energy in kJ/mol for this case in this temperature range. Given that R = 8.314 J/ (mol·K).

(6 marks)

Q3 (a) The results of a tensile test on a 0.2% C plain-Carbon Steel bar are given in **Table Q3(a).** The initial gauge length and the initial diameter of the bar are 25.00 mm and 5.00 mm respectively. The diameter at the fracture is 2.6mm. Plot the engineering stress-strain curve for these data.

(4 marks)

(b) From the engineering stress strain curve plotted in Q3(a), determine :

(i) The 0.2% offset yield strength
(ii) The modulus of elasticity
(iii) The ultimate tensile strength
(iv) The percent reduction of area

(6 marks)

(c) Define creep and illustrate the stages of creep using the Creep Strain,ϵ vs Time,t graph.

(4 marks)

(d) A fatigue test is made with a mean stress of 120 MPa and a stress amplitude of 165 MPa. Calculate :

(i) Maximum stress
(ii) Minimum stresses
(iii) Stress ratio

(6 marks)

Q4 Consider the binary peritectic Iridium-Osmium phase diagram of **Figure Q4(a).** Construct the phase analyses which includes of the phases present, the chemical compositions of the phases, the amounts of each phase and sketch the microstructure by using 2 cm diameter circular fields of a 70 wt % Ir-30 wt % Os at the temperatures of:

(a) 2600°C
(b) 2665°C + ΔT
(c) 2665°C − ΔT
(d) 2800°C

(16 marks)

(e) Create an isothermal transformation diagram for a plain-carbon eutectoid Steel and indicate the various decomposition products on it. Propose how can such a diagram be constructed by a series of experiments.

(4 marks)

Q5 (a) List the properties common to most ceramic materials.

(4 marks)

(b) Draw and propose aircraft parts from a specific aircraft which are made from composite materials.

(6 marks)

(c) Ceramics materials are becoming more important and widely use in aircraft engines. Gives **THREE (3)** advantages and disadvantages of ceramics usage for aircraft engine and propose other materials that can be considered as potential material to replace ceramic.

(8 marks)

(d) Briefly explain the properties of Gold.

(2 marks)

Q6 (a) One of the useful applications of ceramics is used as die blanks. Provide the principle and operations of ceramic application in die blanks by using appropriate illustration.

(5 marks)

(b) Ceramic fabrication techniques involve glass forming, particulate forming and cementation process. Choose one (1) of these techniques and explain in details the process.

(5 marks)

(c) Analyze the four basic structural changes that take place when a homogeneous ductile metal is caused to fail by fatigue under cyclic stresses.

(6 marks)

(d) Injection molding, film stacking, diaphragm forming and Thermoplastic tape laying are four (4) type of forming processes for Thermoplastic matrix composites. Choose one (1) of this forming process and discuss briefly on its process by evaluating the advantages and disadvantages of the chosen process.

(4 marks)

- **END OF QUESTION –**

FINAL EXAM / PEPERIKSAAN AKHIR

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME : 1BDC/1BDM

COURSE : MATERIAL SCIENCE SUBJECT CODE: BDU 10603

TABLE Q2(b): Error Function

z	erf (z)	z	erf (z)
0	0	0.85	0.7707
0.025	0.0282	0.90	0.7970
0.05	0.0564	0.95	0.8209
0.10	0.1125	1.0	0.8427
0.15	0.1680	1.1	0.8802
0.20	0.2227	1.2	0.9103
0.25	0.2763	1.3	0.9340
0.30	0.3286	1.4	0.9523
0.35	0.3794	1.5	0.9661
0.40	0.4284	1.6	0.9763
0.45	0.4755	1.7	0.9838
0.50	0.5205	1.8	0.9891
0.55	0.5633	1.9	0.9928
0.60	0.6039	2.0	0.9953
0.65	0.6420	2.2	0.9981
0.70	0.6778	2.4	0.9993
0.75	0.7112	2.6	0.9998
0.80	0.7421	2.8	0.9999

FINAL EXAM / PEPERIKSAAN AKHIR

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME : 1 BDC/1BDM

COURSE : MATERIAL SCIENCE SUBJECT CODE: BDU 10603

TABLE Q3(a): Tensile test results

Data	Strain	Engineering Stress (MPa)
1	0	0
2	0.0002	42
3	0.0004	83
4	0.0006	125
5	0.0015	155
6	0.005	185
7	0.02	249.7
8	0.03	274.9
9	0.04	293.5
10	0.05	308
11	0.06	319.8
12	0.08	337.9
13	0.1	351.1
14	0.15	371.7
15	0.2	382.2
16	0.22	384.7
17	0.24	386.4
18	0.26	387.6
19	0.28	388.3
20	0.3	388.5
21	0.32	388.4
22	0.34	388
23	0.38	386.5
24	0.4	384.5
25	0.42	382.5
26	0.44	378
27	0.46	362
28	0.47	250

FINAL EXAM / PEPERIKSAAN AKHIR

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME : 1 BDC/1BDM

COURSE : MATERIAL SCIENCE SUBJECT CODE: BDU 10603

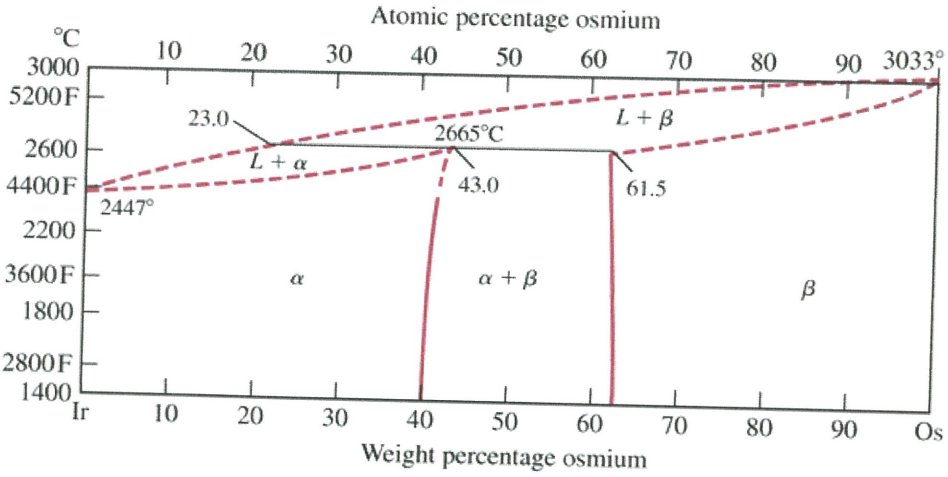

FIGURE Q4(a): The binary peritectic Iridium-Osmium phase diagram