UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	MATERIAL SCIENCE
COURSE CODE	:	BDJ 10602
PROGRAMME CODE	:	BDJ
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWERS **ALL** QUESTIONS
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

TERBUKA

Q1   (a)   Discuss the significance of mechanical engineers having an in-depth knowledge of the composition, characteristics, and processing of materials.

(5 marks)

(b)   Differentiate between atomic structure and crystal structure
(4 marks)

(c)   If there is a single atom at each lattice point. Calculate the number of atoms per unit cell in

(i)   Simple cube (SC),
(ii)   Body-centered cubic (BCC)
(iii)   Face-centered cubic (FCC)

(10 marks)

(d)   Determine the density of based center cubic (BCC) iron, with a lattice parameter of 0.2866 nm (2.866×10^{-8} cm), atomic mass = 55.847 g/mol and Avogadro constant NA = 6.022×10^{23} atoms/mol.

(6 marks)

Q2   (a)   You have been provided with a Metal YXZ for an engineering application. Its properties must be known to affirm Metal YXZ's suitability for the required application. Identify **TWO (2)** mechanical experiments that must be conducted to determine a material's capacity to withstand an applied load and deform plastically by absorbing energy.

(8 marks)

(b)   A cylindrical specimen of aluminium measuring 19 mm (0.75 in) in diameter and 200 mm (8 in) in length is elastically deformed in tension by a force of 48,800 N. (11,000 lbf). Using the information found in **Table Q2(b)** calculate:

(i)   the amount by which this specimen will elongate in the direction of the applied stress.

(5 marks)

(ii)   the change in diameter of the specimen and

(5 marks)

(iii)   predict the diameter increase or decrease.

(2 marks)

(c)   A crankshaft in a diesel engine fails examination and crankshaft reveal no plastic deformation. The fracture surface is smooth. In addition, several crack appear at other locations in the crankshaft. Classify in detail explanation types of failure mechanism would you expected.

(5 marks)

TERBUKA

Q3 (a) Addition Polymerization and Condensation Polymerization are the two varieties of polymerization processes. Sketch **ONE (1)** of the processes and describe it.

(10 markah)

(b) Metal will be used to construct a liquid hydrogen storage vessel, but 3 mm of polymer will be applied as an intermediate layer between the metal and additional insulation layers. The intermediate layer's temperature may drop to -80 degrees Celsius. Identify and briefly describe polymer materials that are suitable for this layer.

(10 marks)

(c) List **FIVE (5)** types of non-ferrous metal. C1

(5 marks)

Q4 (a) Explain about the function of matrix, interface and reinforcement in composite materials.

(b) A unidirectional carbon-fiber-epoxy-resin composite contains 68 percent by volume of carbon fiber and 32 percent epoxy resin. The density of the carbon fiber is 1.79 g/cm3 and that of the epoxy resin is 1.20 g/cm^3.

(i) Calculate the weight percentages of carbon fibers and epoxy resin in the composite

(ii) Calculate the average density of the composite

(12 marks)

(c) Describe **FIVE (5)** properties of ceramic materials and list **TWO (2)** types of ceramic materials.

(7 marks)

-END OF QUESTIONS –

TERBUKA

CONFIDENTIAL

FINAL EXAMINATION
SEMESTER / SESSION : SEM II / 2022/2023   PROGRAMME CODE : BDJ
COURSE NAME   : MATERIAL SCIENCE   COURSE CODE   : BDJ10602

Table Q2(b)

Metal Alloy	Modulus of Elasticity		Shear Modulus		Poisson's Ratio
	GPa	10^6 psi	GPa	10^6 psi	
Aluminum	69	10	25	3.6	0.33
Brass	97	14	37	5.4	0.34
Copper	110	16	46	6.7	0.34
Magnesium	45	6.5	17	2.5	0.29
Nickel	207	30	76	11.0	0.31
Steel	207	30	83	12.0	0.30
Titanium	107	15.5	45	6.5	0.34
Tungsten	407	59	160	23.2	0.28

TERBUKA