



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DGE 1103
COURSE	: MATERIALS SCIENCE
SEMESTER/SESSION	: 1-2022/2023 (APRIL)
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **3** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE

INSTRUCTION: ANSWER ALL THE QUESTIONS**QUESTION 1**

- a) Define the definition given
- i) Isotope (2 Marks)
 - ii) Covalent bond (2 Marks)
 - iii) Metallic bond (2 Marks)
 - iv) Crystal structure (2 Marks)
- b) By referring to periodic table (see appendix), find for element Ir (iridium), for the information obtained from periodic table
- i) Identify group of element, atomic number, relative mass and period (2 marks)
 - ii) Construct electron configuration for the element by using Aufbau's rule (4 marks)
 - iii) Given the crystal structure of Ir is body centred cube (BCC) with lattice constant $a = 314 \text{ pm}$, calculate the radius of the Ir atom (2 marks)
 - iv) Using information from iii), calculate the atomic packing factor and the density of the element (4 marks)

QUESTION 2

- a) Complete Table 1, given below for carbon steel (redraw Table 1 in your answer booklet) (5 Marks)

Types of carbon steel	% of carbon	Application
Low Carbon		
Medium Carbon		
High Carbon		
Ultra High		
Cast Iron		

Table 1

- b) Describe the technique given on how the strength and hardness are achieved in metallic material. Your description must also include size of impurity atoms used, strengthen mechanism, ability to be strengthen by heat treated or cold work
- i) Solid solution hardening (5 marks)
- ii) Precipitation hardening (5 marks)
- c) Galvanising and anodising is two (2) most popular method to prevent corrosion at lower cost. Differentiate both method in term of :- suitable metal to use and corrosion prevention mechanism (10 marks)

- d) State the objective of Bayer process in Aluminium extraction process and describe four (4) of its main stages (9 marks)
- e) Discuss three (3) advantages and disadvantages of titanium alloy in engineering purpose (6 marks)

QUESTION 3

- a) Define for a given terms below

- i) mer (2 marks)
- ii) polymer chain (2 marks)
- iii) hydrocarbon (2 marks)
- iv) unsaturated hydrocarbon (2 marks)
- v) co-polymer (2 marks)

- b) By using ethylene gas as a raw material, describe the process on how a polymer material can be made by this raw material (12 marks)

c) Describe given co-polymers below by completing the given table below (redraw

Table 2 in your answer booklet)

(12 Marks)

Chemical type	Trade name	Major characteristic	Typical application
natural polyisoprene			
styrene-butadiene			
Polysiloxane			
chloroprene			

Table 2

d) Analysis sample taken from PVC plant, has shown a chain molecular weight distribution in Table 3. Complete the table (redraw Table 3 in your answer booklet), and determine the average molecular weight and degree of polymerisation for the particular sample (6 marks)

Molecular weight (gram/mol)	weight fraction
1000	0.08
5000	0.05
8000	0.02
10000	0.20
20000	0.27
30000	0.16
40000	0.22

Table 3

*****END OF QUESTIONS*****

APPENDIX**CRYSTAL PROPERTIES**

$$4R = a\sqrt{3} \quad \text{BCC CRYSTAL}$$

$$4R = a\sqrt{2} \quad \text{FCC CRYSTAL}$$

$$\text{atoms volume} = \text{number of atoms in unit cell} \times \frac{4}{3}\pi R^3$$

$$\text{unit cell volume for BCC and FCC} = a^3$$

$$\text{total atoms mass} = \frac{\text{relative mass}}{N_A} \times \text{number of atom in a unit cell}$$

$$APF = \frac{\text{total atoms volume}}{\text{unit cell volume}}$$

$$\text{density, } \rho = \frac{\text{total atoms mass}}{\text{unit cell volume}}$$

APPENDIX : PERIODIC TABLE

1 H Hydrogen 1.00794	2 He Helium 4.003	3 Li Lithium 6.941	4 Be Beryllium 9.012182	5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797	11 Na Sodium 22.989770	12 Mg Magnesium 24.3050	13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29	55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967	87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (269)	111 Cn Copernicium (272)	112 Fl Flerovium (277)	113 Tl Thallium 204.3833	114 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)
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