


Name:									
Enrolment No:									
<b>UNIVERSITY OF PETROLEUM AND ENERGY STUDIES</b> <b>End Semester Examination, May 2023</b>									
Course: Fundamentals of Material Science.		Semester : IV							
Program: MSc Physics		Time : 03 hrs.							
Course Code: PHYS 7023		Max. Marks: 100							
<b>SECTION A</b> <b>(5Qx4M=20Marks)</b> Attempt All Questions. Each Question will carry 4 Marks									
S. No.		Marks	CO						
Q1	In terms of electron energy band structure, discuss reasons for the difference in electrical conductivity between metals, semiconductors and insulators.	4	CO4						
Q2	What is the role of spin in magnetic materials, and how does it influence their magnetic behavior?	4	CO5						
Q3	Define eutectic point on a phase diagram, and what is its significance in materials science?	4	CO2						
Q4	What is the difference between interstitial and substitutional defects in a crystal lattice, and how do they affect material properties?	4	CO1						
Q5	Explain Seebeck, Peltier and Thomson effects. How Thomson effect is different from joules heating effect?	4	CO3						
<b>SECTION B</b> <b>(4Qx10M= 40 Marks)</b> <b>Each question will carry 10 marks (10x4 = 40 Marks)</b> <b>There is an internal choice for Q9.</b>									
Q6	What are the different types of bonding in materials and how do they affect material properties?	10	CO1						
Q7	Elaborate the different types of electric properties of materials, such as electrical conductivity, dielectric constant, and piezoelectricity? How do these properties influence the behavior of materials in electronic and optical devices?	10	CO4						
Q8	Explain various diffusion mechanisms in solid materials. The diffusion coefficients for iron in nickel are given at following two temperatures: <table style="margin-left: 20px; border: none;"> <tr> <td style="padding-right: 40px;"><math>T</math> (K)</td> <td><math>D</math> (<math>m^2/s</math>)</td> </tr> <tr> <td>1273</td> <td><math>9.4 \times 10^{-16}</math></td> </tr> <tr> <td>1473</td> <td><math>2.4 \times 10^{-14}</math></td> </tr> </table> Determine the values of $D_0$ and the activation energy $Q_d$ .	$T$ (K)	$D$ ( $m^2/s$ )	1273	$9.4 \times 10^{-16}$	1473	$2.4 \times 10^{-14}$	10	CO1
$T$ (K)	$D$ ( $m^2/s$ )								
1273	$9.4 \times 10^{-16}$								
1473	$2.4 \times 10^{-14}$								

Q9	<p>Elaborate Kronig Penney model for one dimensional solids. Explain origin of energy bandgap in solids.</p> <p style="text-align: center;">OR</p> <p>Define different classifications of crystal defects and explain any two of the defects.</p>	<b>10</b>	<b>CO4</b>
		<b>10</b>	<b>CO1</b>
<p><b>SECTION-C</b> (2Qx20M=40 Marks)</p> <p><b>1. Each Question carries 20 Marks.</b> <b>2. Attempt two questions. There is an internal choice for Q11.</b></p>			
Q10	<p>(a) What are the fundamental principles underlying the optical properties of materials, such as absorption, reflection, and transmission of light?</p> <p>(b) How can the band structure and electronic properties of a material be used to predict its optical behavior?</p> <p>(c) What are some examples of materials with interesting optical properties, and how are they used in different applications, such as photovoltaics and display technologies?</p>	<b>10</b>	<b>CO6</b>
		<b>5</b>	
		<b>5</b>	
Q11	<p>How do magnetic properties of materials arise, and what are some of the factors that determine their behavior? What are the different types of magnetic materials, and how do they differ in terms of their magnetic properties? How can the study of magnetic materials be used to develop new technologies, such as magnetic storage and sensing devices?</p> <p style="text-align: center;">OR</p> <p>What is a phase diagram, and how can it be used to understand the behavior of materials under different temperature and pressure conditions? What are the different types of phase diagrams, and how do they differ in terms of their shape and the information they provide about the system? How can phase diagrams be used to predict the formation of different phases and the occurrence of phase transformations in materials?</p>	<b>20</b>	<b>CO5</b>
		<b>20</b>	<b>CO2</b>