LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

FIFTH SEMESTER – **NOVEMBER 2023**

UPH 5602 – MATERIALS SCIENCE

Date: 16-11-2023   Dept. No.   Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**MCQ**	
a)	Sharing of electrons between neighbouring atoms result in………………..	
	(a)Metallic bond (b) ionic bond (c) covalent bond (d) none of the above	
b)	Ceramic materials are ………………………..	
	(a) good conductors of electricity (b) basically crystalline oxides or metals	
	(c) Inorganic compounds of metallic and non – metallic elements (d) organic compounds	
c)	Which of the following magnetic materials have a small area of hysteresis loop?	
	(a) soft magnetic material (b) hard magnetic material (c) diamagnetic material (d) para magnetic material	
d)	Ultrasonic testing is done in materials to determine…………………	
	(a) crack below the surface (b) yield strength (c) ultimate tensile strength (d) force	
e)	Thermal analysis is defined as …………………	
	(a) Measurement of concentration of materials as a function of temperature.	
	(b) Measurement of solubility of materials as a function of temperature.	
	c) Measurement of physical properties as a function of temperature.	
	d) Measurement of line positions of crystals as a function of temperature.	
2.	**Fill in the blanks**	
a)	Primary bonds have energy in the range of……………… kJ / mol.	
b)	The ratio of lateral stress to linear strain is………………….	
c)	The abbreviation of MEMS is ……………………………	
d)	The value of B at H=0 in a Hysteresis curve is called ……………	
e)	The piezoelectric materials used for converting energy are called as ………………..	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**True or False**	
a)	An example for covalent bond is NaCl.	
b)	Stress, like pressure, is always perpendicular to a plane.	
c)	When temperature increases, the magnetic susceptibility of a ferromagnetic material decreases..	
d)	Active dielectrics materials are easily adaptable to store electrical energy.	
e)	NDT plays an important role in quality control of a material.	
4.	**Definitions**	
a)	Lattice Energy.	
b)	Hooke's law.	
c)	Smart material.	
d)	Magnetic Induction.	
e)	Magnetic method of testing in NDT.	

	SECTION B - K3 (CO2)	
	Answer any TWO of the following in 100 words	**(2 x 10 = 20)**
5.	(a) Classify the levels of structure.	(6 marks)
	(b) Outline the Born-Haber cycle for the formation of NaCl.	(4marks)
6.	Draw the stress – strain curve for a material and explain the various regions of interest.	
7.	With a neat sketch, explain the working of a metallurgical microscope.	
8.	Discuss the essential properties of ferroelectric materials and explain the structure of Barium titanate ($BaTiO_3$).	
	SECTION C – K4 (CO3)	
	Answer any TWO of the following in 100 words	**(2 x 10 = 20)**
9.	How will you determine the mechanical hardness of the material using Vicker's microhardness tester?	
10.	Explain the classification of magnetic materials with suitable diagrams and examples.	
11.	Explain the types of solar materials in detail.	
12.	Briefly explain the role of elastic modulus as an important parameter in design.	
	SECTION D – K5 (CO4)	
	Answer any ONE of the following in 250 words	**(1 x 20 = 20)**
13.	(a) Discuss the formation of ionic bond in sodium chloride crystal and hence obtain the expression for the potential energy of the system.	(8 marks)
	(b)Identify the various polarization mechanisms and discuss the effect of frequency and temperature on dielectric materials with necessary diagrams.	(8 +4 marks)
14.	(a) What are shape memory alloys (SMA)? Explain the one way and two-way memory effect of SMA with diagrams.	(10 marks)
	(b) What are elastomers? Obtain the expression for rubbery state by thermodynamic considerations.	(10 marks)
	SECTION E – K6 (CO5)	
	Answer any ONE of the following in 250 words	**(1 x 20 = 20)**
15.	(a)Outline the atomic model of elastic behaviour. Obtain the relation between Young's modulus Y, Rigidity modulus K, bulk modulus G and Poisson's ratio σ.	(12 marks)
	(b) With neat diagram, explain the piezoelectric effect and highlight the applications of piezoelectric materials.	(8 marks)
16.	(a)Write a note on nanomaterials and their properties.	(8 marks)
	(b) Explain the principle, instrumentation and characterization of materials by FTIR spectroscopy.	(12 marks)

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