LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2023**

PPH3ID01 – NANOSCIENCE

Date: 09-11-2023 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

	SECTION A – K1 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
1.	**Answer the following**	
a)	Distinguish nanoscience and nanotechnology.	
b)	Recall surface plasmon resonance effect.	
c)	Calculate the crystallite size of a nanocrystal by XRD radiation of wavelength 0.154 nm, full width at half maximum 0.5^o located at 31.8^o in the pattern.	
d)	What is a buckyball? (a) Carbon-60 (b) Carbon-111 (c) Carbon-4 (d) Carbon-20	
e)	Nanomaterials with same dimensions but with different structure might have different physical properties. (True/False)	
	SECTION A – K2 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
2.	**MCQ**	
a)	Elemental iodine (I_2) is a solid at room temperature. What is the major attractive force that exists among the different I_2 molecules in the solid? a) covalent-ionic interactions b) london dispersion forces c) dipole-dipole attractions d) none of the above	
b)	_____is a material produced by the incomplete combustion of heavy petroleum products. a) activated carbon b) charcoal c) carbon block d) graphite	
c)	The synthesis of nanomaterials using the co-precipitation route is the_____ method. a) top-up & solid phase b) bottom-up & sedimentation c) top-up & chemical d) chemical	
d)	The most commonly used anode X-ray source in XPS analysis is the _____. a) Mg Kα b) Al Kα c) Ni Lα d) both a) and b)	
e)	_____emission is the emission of electrons induced by an applied electrostatic field. a) Thermal b) Field c) Electric d) Secondary	
	SECTION B – K3 (CO2)	
	Answer any THREE of the following in 300 words	**(3 x 10 = 30)**
3.	Justify why materials change their properties at nanoscale with few examples.	
4.	Elaborate the principle and working of physical vapour deposition method with a neat graphical schema.	

5.	a) Discuss the role of nanotechnology in energy sector. b) What is Lennard-Jones potential? Explain its significance. (5 + 5)
6.	a) How are semiconductor nanocomposites classified? b) How are Langmuir-Blodgett films prepared? (5 + 5)
7.	a) Discuss the working principle of X-ray photoelectron spectroscopy. b) Illustrate the application of CNTs in fuel cell. (5 + 5)
	SECTION C – K4 (CO3)
	Answer any TWO of the following in 500 words (2 x 12.5 = 25)
8.	Explain the electrical, magnetic, optical and thermal properties of nanostructured materials.
9.	Illustrate the principle, essential components and operation of UV-Vis spectroscopy with a neat graphical scheme.
10.	a) Compare the electronic band structure of 0D, 1D, and 2D nanomaterials. b) Discuss the types and advantages of core-shell nanoparticles. (6 + 6.5)
11.	a) How are metal oxide nanostructures synthesized using sol gel method? b) The experimental data for the adsorption of nitrogen on silica at 77.3 K fit into a BET isotherm. The slope and intercept of a plot of $P/[V(P_0–P)]$ and P/P_0 are 2.88 x 10^{-2} cm^{-3} and 9.87 x 10^{-4} cm^{-3}. The area of the cross section of the N_2 molecule is 16.2 x 10–20 m^2. Calculate V_{mono} and the surface area of silica. (6 + 6.5)
	SECTION D – K5 (CO4)
	Answer any ONE of the following in 750 words (1 x 15 = 15)
12.	Classify nanomaterials based on dimensionality, quantum confinement and morphology with necessary illustrations.
13.	a) Write Brunauer–Emmett–Teller equation. Explain its application. (7 + 8) b) How is energy dispersive spectroscopy performed for elemental analysis of nanomaterials?
	SECTION E – K6 (CO5)
	Answer any ONE of the following in 1000 words (1 x 20 = 20)
14.	Review the principle, essential components and working of Transmission Electron Microscopy with a neat graphical representation. Mention few applications.
15.	a) Explain the nonbonding intermolecular forces with suitable equations b) Discuss the synthesis of nanomaterials and the types of reactions involved in chemical vapor deposition. (10 + 10)

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