

PHYSICS OF NANOSCIENCE

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	What is the primary factor that distinguishes nanomaterials from bulk materials? (i) Color (ii) Weight (iii) Surface to volume ratio (iv) Electrical resistance	K1	CO1
	2	Which phenomenon describes the confinement of electrons in one, two, or three dimensions in nanomaterials? (i) Band offsets (ii) Quantum transport (iii) Superlattices (iv) Quantum confinement	K2	CO1
2	3	What process involves compacting nanopowders to form a solid mass? (i) Sintering (ii) Ball milling (iii) Electrodeposition (iv) Lithography	K1	CO2
	4	What critical aspects are highlighted regarding the preparation of nanomaterials? (i) Optical and electronic properties (ii) Porosity and impurities (iii) Compaction and sintering (iv) Preparation, safety and storage issues	K2	CO2
3	5	Which method is a "bottom-up" approach for synthesizing nanomaterials? (i) Ball milling (ii) Lithography (iii) Czochralski methods (iv) Sol-gel synthesis	K1	CO3
	6	Which technique is used for growing single crystals? (i) DC Magnetron sputtering (ii) Bridgeman Technique (iii) Molecular beam epitaxy (MBE) (iv) Colloidal methods	K2	CO3
4	7	What technique is used for studying stoichiometry in nanomaterials? (i) Photoluminescence spectra (PL) (ii) FTIR Spectroscopy (iii) Energy dispersive X-ray analysis (EDAX) (iv) Electrical resistivity measurements	K1	CO4
	8	Which method is used to calculate the lattice parameter and size/strain analysis from XRD data? (i) Double Dabble method (ii) Transmission method (iii) Scherrer method (iv) Atomic Force method	K2	CO4
5	9	Nanomaterials are used in which field of medicine? (i) Drug delivery medicine (ii) Surgical procedures (iii) X-ray imaging (iv) Organ transplantation	K1	CO5
	10	Quantum dots have applications in which area? (i) Giant magnetoresistance (ii) Photocatalyst (iii) Automobiles (iv) Energy and environment applications	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Analyze the Surface to Volume Ratio.	K2	CO1
		(OR)		
	11.b.	Explain the concept Quantum Confinement.		
2	12.a.	Elaborate thermal and chemical properties of Nanomaterials.	K4	CO2
		(OR)		
	12.b.	Explain the steps involved in the compaction and sintering of nanopowders, including the role of impurities.		
3	13.a.	Compare the Bottom-up and Top-down Approaches.	K3	CO3
		(OR)		
	13.b.	Describe the stages of the sol-gel process and its advantages in producing high-purity nanomaterials.		
4	14.a.	Compare Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM).	K5	CO4
		(OR)		
	14.b.	Explain the instrumentation and operational modes of AFM for surface morphology analysis at the nanoscale.		
5	15.a.	Explain the role of magnetic nanoparticles in hyperthermia and the advantages of targeted drug delivery systems.	K5	CO5
		(OR)		
	15.b.	Discuss the use of nanomaterials in modern automobiles and their role as high-efficiency photocatalysts.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions
ALL questions carry **EQUAL** Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Explain the fundamental interactions of X-rays and electrons with matter. Describe how these interactions are utilized in characterizing nanomaterials.	K2	CO1
2	17	Discuss the electronic, magnetic, and biological properties of nanomaterials. Provide specific examples of how these properties are leveraged in biological systems.	K4	CO2
3	18	Describe and compare the Czochralski, Bridgeman and Zone melting methods for the growth of single crystals.	K3	CO3
4	19	Describe the X-ray Diffraction (XRD) technique and its application in material characterization. Explain the Scherrer method for calculating crystallite size.	K5	CO4
5	20	Explain the application of quantum dots and the phenomenon of giant magnetoresistance (GMR).	K5	CO5

Z-Z-Z

END