R2817

Sub. Code
533201

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Nanoscience and Technology

SYNTHESIS OF NANOMATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the questions by choosing the correct option.

1. What is the primary application of carbon nanotubes? (CO5, K6)

   (a) Drug delivery

   (b) Catalysis

   (c) Collection and analysis of evidence

   (d) None of the above

2. Which physical method is widely used for nanoparticle synthesis? (CO1, K3)

   (a) Sol-gel method

   (b) Inert gas condensation

   (c) Hydrothermal synthesis

   (d) Electrospinning

3. What is the key principle behind the hydrothermal synthesis of nanomaterials? (CO3, K4)

(a) High-energy ball milling

(b) Controlled precipitation at high pressure and temperature

(c) Microwave radiation interaction

(d) Laser-assisted evaporation

4. Which of the following is a top-down approach for nanomaterial synthesis? (CO4, K3)

(a) Ball milling (b) Sol-gel method

(c) Co-precipitation (d) Sonochemical synthesis

5. Which nanomaterial synthesis method involves the use of plant extracts? (CO5, K3)

(a) Solvothermal synthesis

(b) Phytosynthesis

(c) Electrochemical synthesis

(d) Plasma arc technique

6. What is the purpose of a surfactant in the sol-gel process? (CO2, K3)

(a) Control the size of nanomaterials

(b) Increase reaction temperature

(c) Decrease crystallization rate

(d) None of the above

7. What is the advantage of RF magnetron sputtering? (CO1, K3)

(a) High material deposition rate

(b) Low-cost synthesis

(c) Suitable only for polymers

(d) Requires chemical precursors

8. What is a characteristic feature of biomimetics in nanotechnology? (CO5, K3)

(a) Using synthetic chemicals to mimic biological functions

(b) Using biological principles to develop new materials

(c) Forming nanostructures using magnetic fields

(d) Combining nanoparticles with mechanical forces

9. Which method is commonly used to fabricate quantum dots? (CO3, K4)

(a) Schlenk synthesis

(b) RF sputtering

(c) Thermal evaporation

(d) Arc discharge

10. What is the significance of severe plastic deformation in nanomaterials? (CO4, K3)

(a) Improves mechanical strength

(b) Reduces electrical conductivity

(c) Increases oxidation rate

(d) Prevents grain growth

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) Discuss the concepts of nanoscience and technology. (CO1, K6)

Or

(b) Compare metals and semiconductor nanomaterials. (CO1, K2)

12. (a) Explain the solvothermal synthesis method in detail. (CO2, K3)

Or

(b) Describe the process of photochemical synthesis of nanoparticles. (CO2, K3)

13. (a) How does hydrothermal synthesis help in fabricating nanorods? (CO3, K4)

Or

(b) Discuss the role of Schlenk synthesis in quantum dot formation. (CO3, K4)

14. (a) Explain the principle of high-energy ball milling and its applications. (CO4, K3)

Or

(b) What are the major challenges in mechanical methods for nanomaterial synthesis? (CO4, K3)

15. (a) What are DNA-templated nanostructures, and how are they formed? (CO5, K3)

Or

(b) Explain the role of biomimetics in designing bio-inspired nanomaterials. (CO5, K3)

Part C (5 × 8 = 40)

Answer **ALL** the questions not more than 1000 words each.

16. (a) Explain the different implications of nanotechnology in physics, chemistry, and biology. (CO1, K2)

Or

(b) Classify the different types of nanomaterials based on their organic and inorganic nature. (CO1, K2)

17. (a) Elaborate on the sol-gel technique and discuss how grain size can be controlled. (CO2, K3)

Or

(b) Compare the advantages and limitations of electrochemical synthesis and sonochemical synthesis. (CO2, K3)

18. (a) Describe the synthesis and applications of nanoflowers and nano-rings. (CO3, K4)

Or

(b) Discuss the various techniques involved in the chemical synthesis of 1D nanotubes. (CO3, K4)

19. (a) Explain the process and optimization strategies involved in severe plastic deformation for nanomaterial fabrication. (CO4, K3)

Or

(b) How does the melt-quenching process help in forming nanomaterials? (CO4, K3)

20. (a) Discuss the different biological synthesis approaches, including phytosynthesis, psychosynthesis, and mycosynthesis. (CO5, K3)

Or

(b) Explain the role of protein-based nanostructures in biomedical applications. (CO5, K3)

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R2818

Sub. Code
533202

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Nanoscience and Technology

CHARACTERIZATION OF NANOMATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the questions by choosing the correct option.

1. X-ray diffraction (XRD) is primarily used to determine: (CO1, K2)

   (a) Surface roughness

   (b) Crystal structure

   (c) Molecular vibrations

   (d) Optical properties

2. The Scherrer equation is used to estimate: (CO1, K2)

   (a) Conductivity (b) Crystal size

   (c) Porosity (d) Surface charge

3. Raman spectroscopy is based on: (CO2, K3)

   (a) Elastic scattering (b) Inelastic scattering

   (c) Electron emission (d) Optical absorption

4. The resolution of a transmission electron microscope (TEM) is higher than a scanning electron microscope (SEM) due to: (CO2, K3)

(a) Longer electron wavelength

(b) Shorter electron wavelength

(c) Higher accelerating voltage

(d) Lower accelerating voltage

5. Fourier Transform Infrared Spectroscopy (FTIR) is useful for: (CO3, K1)

(a) Identifying crystal structure

(b) Detecting functional groups

(c) Measuring electrical conductivity

(d) Observing magnetic domains

6. The BET method is used to determine: (CO3, K1)

(a) Magnetic properties

(b) Surface area

(c) Thermal stability

(d) Optical transmittance

7. In TEM, the contrast mechanism for imaging nanoparticles is primarily based on: (CO4, K4)

(a) Surface roughness variations

(b) Fluorescence emission

(c) Atomic number contrast and diffraction contrast

(d) Magnetic susceptibility

8. The Langmuir adsorption model assumes that: (CO4, K4)

(a) Adsorption occurs in multilayers

(b) There is no interaction between adsorbed molecules

(c) Surface energy varies across the adsorbent

(d) Surface sites are not equivalent

9. The Stokes shift in photoluminescence spectroscopy is the difference between: (CO5, K6)

(a) Incident and reflected wavelengths

(b) Absorbed and emitted photon energies

(c) Scattered and absorbed electron wavelengths

(d) Infrared and visible absorptions wavelengths

10. Which technique can provide depth profiling of a material's surface composition? (CO5, K6)

(a) XRD (b) XPS

(c) BET (d) Raman

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) Explain the principle and applications of X-ray diffraction (XRD). (CO1, K2)

Or

(b) Discuss the working principle of FTIR and its role in characterizing nanomaterials. (CO1, K2)

12. (a) Compare the differences between SEM and TEM. (CO2, K3)

Or

(b) Explain how UV-Vis spectroscopy is used to study nanomaterials. (CO2, K3)

13. (a) Describe the principle and applications of Raman spectroscopy. (CO3, K1)

Or

(b) How does the BET method help in determining surface area? (CO3, K1)

14. (a) Explain how Electron Energy Loss Spectroscopy (EELS) can be used to study elemental composition and bonding in nanomaterials. (CO4, K4)

Or

(b) Compare the mechanisms of BET and Langmuir models for surface area determination and explain when each is more applicable. (CO4, K4)

15. (a) Discuss the role of phase contrast imaging in High-Resolution Transmission Electron Microscopy (HRTEM) and its advantages over conventional imaging. (CO5, K6)

Or

(b) How does thermogravimetric analysis (TGA) help in studying the kinetic parameters of nanoparticle degradation? Explain using relevant equations. (CO5, K6)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Describe in detail the working principle, instrumentation, and applications of X-ray Photoelectron Spectroscopy (XPS). (CO1, K2)

Or

(b) Explain the importance of DSC and TGA in nanomaterial characterization. (CO1, K2)

17. (a) Differentiate between UV-Vis absorption spectroscopy and photoluminescence spectroscopy. (CO2, K3)

Or

(b) Explain the principle of EELS in TEM and how it is used for elemental analysis. (CO2, K3)

18. (a) Discuss the working principle and applications of SQUID magnetometry. (CO3, K1)

Or

(b) How does surface functionalization impact the properties of nanomaterials? (CO3, K1)

19. (a) Discuss the significance of Raman spectroscopy in analyzing lattice defects, phonon confinement effects, and stress in nanomaterials. (CO4, K4)

Or

(b) Explain the combined use of XPS and UPS (Ultraviolet Photoelectron Spectroscopy) for analyzing electronic structure and surface chemistry of nanomaterials. (CO4, K4)

20. (a) What are the fundamental challenges in in-situ electrochemical characterization of nanomaterials? Discuss methods like in-situ TEM and electrochemical impedance spectroscopy (EIS). (CO5, K6)

Or

(b) Discuss the different modes of Atomic Force Microscopy (AFM) and their suitability for studying different properties of nanomaterials. (CO5, K6)

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R2819

Sub. Code
533203

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Nanoscience and Technology

APPLICATION OF NANOMATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the questions, choosing the correct option.

1. In microelectronics, Moore's Law states that: (CO1, K3)
   (a) The cost of microchips doubles every two years
   (b) The number of transistors on a chip doubles every two years
   (c) The size of transistors remains constant over time
   (d) The power dissipation of a chip remains unchanged
2. The electronic properties of CNTs depend on: (CO1, K3)
   (a) The atomic number of carbon
   (b) Their chirality and diameter
   (c) The surrounding air pressure
   (d) The number of protons in the nucleus
3. Soft magnetic materials are primarily used in high-speed memory applications because of their: (CO2, K3)
   (a) High coercivity and low permeability
   (b) Low coercivity and high permeability
   (c) High hysteresis loss
   (d) High remanence

4. Which of the following is an example of a hard magnetic material? (CO2, K3)

   (a) Iron-Silicon alloy

   (b) Neodymium Iron Boron (NdFeB)

   (c) Permalloy

   (d) Ferrite core transformer material

5. One of the primary biomedical applications of hydroxyapatite is: (CO3, K6)

   (a) Semiconductor manufacturing

   (b) Bone grafts and dental implants

   (c) Textile dyeing

   (d) Fuel cell development

6. Enzymes function as biological catalysts by: (CO3, K6)

   (a) Increasing the activation energy of reactions

   (b) Decreasing the activation energy of reactions

   (c) Changing the chemical composition of reactants

   (d) Being consumed in the reaction

7. The efficiency of dye degradation using TiO photocatalysis is enhanced by. (CO4, K4)

   (a) Increasing the pH of the solution

   (b) Using UV or visible light illumination

   (c) Adding heavy metals

   (d) Decreasing the temperature

8. Selective gas detection in sensors can be achieved by: (CO4, K4)

   (a) Modifying the sensor material's surface properties

   (b) Increasing the humidity of the environment

   (c) Lowering the temperature of the sensor

   (d) Using a single sensor for all gases

9. In an electrochemical glucose sensor, glucose oxidase catalyzes the oxidation of glucose to: (CO5, K6)

(a) Carbon dioxide and water

(b) Gluconic acid and hydrogen peroxide

(c) Pyruvate and ATP

(d) Ethanol and acetic acid

10. Biofunctionalization of CNTs is primarily done to: (CO5, K6)

(a) Improve mechanical strength

(b) Increase biological compatibility and specificity

(c) Decrease electrical conductivity

(d) Prevent CNT aggregation in solvents

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) Explain photolithography. (CO1, K3)

Or

(b) Explain how carbon nanotubes are used in electronic applications. (CO1, K3)

12. (a) Compare soft magnets and hard magnets. (CO2, K3)

Or

(b) Explain in detail about High energy density Batteries. (CO2, K3)

13. (a) Explain catalysis. (CO3, K6)

Or

(b) Write a short note on Aerospace components. (CO3, K6)

14. (a) Define organic dye degradation. (CO4, K4)

Or

(b) Compare Detoxification of organic and inorganic pollutants. (CO4, K4)

15. (a) Explain in detail about glucose detection. (CO5, K6)

Or

(b) Write a note on artificial organs and implants. (CO5, K6)

Part C $(5 \times 8 = 40)$

Answer **all** the questions not more than 1000 words each.

16. (a) Explain microelectronics, molecular electronics and nanoelectronics. (CO1, K3)

Or

(b) Explain CNT based MOSFET and NEMSCMOS technology. (CO1, K3)

17. (a) Explain how hard magnets are used in biological applications. (CO2, K3)

Or

(b) Explain how soft magnets are used for high speed memories. (CO2, K3)

18. (a) Explain in detail about the membranes that are used in the purification of water. (CO3, K6)

Or

(b) Write a short note on inductive bone replacements. (CO3, K6)

19. (a) Explain textile and leather industries. (CO4, K4)

Or

(b) Explain sensors for gases. (CO4, K4)

20. (a) Explain in detail about biosynthetic coatings. (CO5, K6)

Or

(b) Write a note on Bio–functionalization of CNT and Explain its biological applications. (CO5, K6)

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R2820

Sub. Code
533503

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Nanoscience and Technology

Elective : INFORMATION STORAGE MATERIALS AND DEVICES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions.

1. Which nanomaterial is commonly used to improve data storage capacities? (CO1, K1)

   (a) Silver (b) Graphene

   (c) Aluminium (d) Brass

2. Molecular storage, enabled by nanotechnology, stores data at the: (CO1, K1)

   (a) Atomic or molecular level

   (b) Millimeter level

   (c) Macroscopic level

   (d) None of the above

3. Optical data storage uses which of the following to store data? (CO2, K2)

   (a) Magnetic fields

   (b) Light and Laser technology

   (c) Electrical impulses

   (d) None of the above

4. One advantage of optical data storage over magnetic storage is: (CO2, K2)

   (a) Slower access time

   (b) Higher durability

   (c) Lower storage density

   (d) Limited compatibility

5. A material that can be magnetized and retains its magnetism is called. (CO3, K2)

   (a) Ferromagnetic (b) Paramagnetic

   (c) Diamagnetic (d) Non–magnetic

6. The transition from ferromagnetism to superparamagnetic occurs when. (CO3, K2)

   (a) The temperature decreases

   (b) The particle size decreases below a critical size

   (c) The magnetic field increases

   (d) None of the above

7. The capacity of magnetic media storage is primarily limited by : (CO4, K5)

   (a) Material strength (b) Magnetic domain size

   (c) Colour contrast (d) None of the above

8. Magnetic media store data by: (CO4, K5)

   (a) Using electric fields

   (b) Aligning magnetic domains

   (c) Transmitting light waves

   (d) None of the above

9. One advantage of MRAM over traditional DRAM is. (CO5, K4)

(a) Lower power consumption

(b) Slower access times

(c) Larger cell size

(d) Volatility

10. Which type of memory is non-volatile and combines the advantages of both SRAM, DRAM? (CO5, K4)

(a) SRAM (b) DRAM

(c) MRAM (d) Flash memory

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) What are the different types of information storage materials? (CO1, K1)

Or

(b) Explain in detail about Optical memory. (CO1, K1)

12. (a) Explain in detail about Signal modulation and data reproduction. (CO2, K2)

Or

(b) Explain Servo-loop design. (CO2, K2)

13. (a) Compare ferromagnetic and anti-ferromagnetic materials. (CO3, K2)

Or

(b) Explain Super Para magnetism. (CO3, K2)

14. (a) Compare AMR head and GMR head. (CO4, K5)

Or

(b) Explain in detail about Longitudinal recording media. (CO4, K5)

15. (a) Distinguish DRAM, SRAM, MRAM. (CO5, K4)

Or

(b) Explain in detail about probe storage. (CO5, K4)

Part C ($5 \times 8 = 40$)

Answer **all** the questions not more than 1000 words each.

16. (a) Describe the role of nanotechnology in data storage. (CO1, K1)

Or

(b) Explain in detail about solid state memory and magnetic recording. (CO1, K1)

17. (a) Illustrate Magnetooptic disks. (CO2, K2)

Or

(b) Explain in detail about Focusing and tracking error signals. (CO2, K2)

18. (a) Explain magnetic hysteresis. (CO3, K2)

Or

(b) Explain spin exchange coupling. (CO3, K2)

19. (a) Determine Superparamagnetic limit. (CO4, K5)

Or

(b) Explain in detail about magnetic tunnelling junction. (CO4, K5)

20. (a) Explain FeRAM and CRAM, RRAM. (CO5, K4)

Or

(b) Explain molecular memory and atomic memory. (CO5, K4)

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R2821

Sub. Code
533401

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Fourth Semester

Nanoscience and Technology

NANO TOXICOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the questions by choosing the correct option.

1. Which of the following is NOT a major route of nanoparticle entry into the human body? (CO1, K1)

   (a) Lungs (b) Skin

   (c) Ears (d) Intestinal tract

2. What property of nanomaterials significantly affects their toxicity? (CO1, K1)

   (a) Color (b) Surface charge

   (c) Taste (d) Weight

3. Which mechanism is responsible for reactive oxygen species (ROS) generation in nanotoxicology? (CO2, K2)

   (a) Cellular uptake (b) Hemolytic activity

   (c) Oxidative stress (d) Membrane translocation

4. Nanoparticles have the ability to reach the circulatory system via: (CO2, K2)

   (a) Skin absorption (b) Neuronal translocation

   (c) Both (a) and (b) (d) None of the above

5. The MTT assay is used to measure: (CO3, K2)

(a) DNA fragmentation

(b) Cell viability

(c) Protein synthesis

(d) Enzyme activity

6. What does the Ames Test assess? (CO3, K2)

(a) Acute toxicity (b) Mutagenicity

(c) Neurotoxicity (d) Respiratory toxicity

7. Which of the following nanoparticles has been linked to potential genotoxicity? (CO4,K5)

(a) Gold nanoparticles

(b) Silver nanoparticles

(c) Carbon nanotubes

(d) All of the above

8. What does LD50 refer to? (CO4, K5)

(a) Lethal dose for 50% of the population

(b) Lowest dose of toxicity

(c) The time taken to reach toxicity

(d) None of the above

9. Ethical concerns in nanotechnology involve: (CO5, K3)

(a) Regulatory policies

(b) Environmental impact

(c) Human safety

(d) All of the above

10. Which of the following is a commonly used in vivo model for nanotoxicity studies? (CO5, K3)

(a) Yeast (b) Zebra fish

(c) Fruit flies (d) None of the above

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) Describe the major routes of entry for nanoparticles into the human body. (CO1, K1)

Or

(b) Explain the role of surface charge and solubility in nanotoxicity. (CO1, K1)

12. (a) Explain oxidative stress and its role in nanoparticle-induced toxicity. (CO2, K2)

Or

(b) How do nanoparticles interact with biological membranes? (CO2, K2)

13. (a) What are the potential health effects of nanoparticle exposure? (CO3, K2)

Or

(b) Outline the regulatory guidelines for nanomaterial safety. (CO3, K2)

14. (a) Discuss the advantages and limitations of in vitro nanotoxicology studies. (CO4, K5)

Or

(b) Differentiate between acute and chronic toxicity in nanomaterials. (CO4, K5)

15. (a) What is the importance of risk assessment in nanotechnology? (CO5, K3)

Or

(b) How is nanoparticle dosimetry performed for toxicity evaluation? (CO5, K3)

Part C (5 × 8 = 40)

Answer **all** the questions, not more than 1000 words each

16. (a) What are the environmental impacts of nanomaterials and strategies for sustainable use? (CO1, K1)

Or

(b) Describe case studies in nanotoxicology and lessons learned from real-world applications. (CO1, K1)

17. (a) Explain the mechanisms of cellular uptake of nanoparticles and their toxicological impact. (CO2, K2)

Or

(b) Discuss the role of oxidative stress, inflammation, and genotoxicity in nanoparticle toxicity. (CO2, K2)

18. (a) Explain the process of neuronal translocation of nanoparticles and its health implications. (CO3, K2)

Or

(b) Outline the toxicity mechanisms of nanoparticles in the liver, spleen, and kidney. (CO3, K2)

19. (a) Describe the methodologies used for nanotoxicity assessment (in vitro and in vivo). (CO4, K5)

Or

(b) Compare the different in vivo models used for nanotoxicity assessment and their significance. (CO4, K5)

20. (a) Discuss the ethical, legal, and social implications of nanotechnology in medicine. (CO5, K3)

Or

(b) Explain the role of patents and intellectual property rights (IPR) in nanotoxicology. (CO5, K3)