



## Avinashilingam Institute for Home Science and Higher Education for Women

Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD (now MoE)

Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC

Coimbatore - 641 043, Tamil Nadu, India

### Master's Degree Examination – May 2025

#### II Semester

Class : I P.G.  
Major : Physics

Time: 3 Hours  
Max. Marks: 100

#### 23MCHI01 Nanomaterials and their Applications

##### Course Outcomes:

CO1: Appreciate the state of art developments in nanotechnology

CO2: Identify common themes across nanotechnology

CO3: Predict major properties of metal nanoparticles and carbon clusters

CO4: Identify the various characterization methods for nanoparticles

CO5: Gain familiarization on the application of Nano particles

##### Part A

10 x 1 = 10

##### Choose the Correct Answer

- Which of the following is a "top-down" approach for the synthesis of nanomaterials? CO1K1
  - Chemical vapor deposition
  - High-energy ball milling
  - Sol-gel method
  - Langmuir-Blodgett method
- Which of the following is NOT a biogenic method for nanoparticle synthesis? CO1K2
  - Using fungi
  - Using algae
  - Using high-energy ball milling
  - Using bacteria
- Identify one common application of metal nanoparticles? CO2K3
  - Batteries
  - Catalysis
  - Insulation
  - Food preservatives
- The colour change observed in metal nanoparticle sols is primarily due to: CO2K3
  - Change in temperature
  - Surface plasmon resonance
  - Change in pH
  - Change in nanoparticle shape
- What does X-ray diffraction (XRD) primarily measure in nanomaterials? CO3K1
  - Optical properties
  - Crystallographic structure
  - Surface area
  - Electrical conductivity
- The resolution of Atomic Force Microscopy (AFM) is most useful for observing CO3K1
  - Large-scale surface features
  - Atomic-scale surface details
  - Internal material composition
  - Optical properties of materials
- Alkali doping of C<sub>60</sub> results in which of the following properties? CO4K2
  - Superconductivity
  - Increased hardness
  - Electrical insulation
  - Higher temperature stability
- Which of the following is a synthetic strategy used for the growth of nanowires? CO4K1
  - Gas-phase growth
  - Liquid-phase deposition
  - Freezing growth
  - Ion implantation
- Nanomedicines are used to CO5K1
  - Create energy-efficient devices
  - Improve agricultural processes
  - Treat diseases at the molecular level
  - Produce lightweight materials
- Which of the following is a key property of nanoparticles used in sensors? CO5K2
  - They are larger in size than traditional sensors
  - They have a high surface area, making them sensitive to environmental changes
  - They are rigid and inflexible
  - They have low surface area

**Part B**

**5 x 6 = 30**

**Answer ALL questions**

**Each answer should not exceed 400 words or two pages**

- 11.a. Explain the concept of nanotechnology and its importance in modern science. CO1K2  
(or)
- 11.b. Demonstrate the role of nanoparticles in water purification. CO1K4
- 12.a. Discuss the applications of alloy nanoparticles in various fields. CO2K4  
(or)
- 12.b. Explain the impact of size and shape on the properties of metal nanoparticles in catalysis. CO2K2
- 13.a. Discuss the role of UV-VIS spectroscopy in analyzing nanomaterials and their properties. CO3K4  
(or)
- 13.b. Explain the significance of SEM in studying the surface morphology of nanoparticles. CO3K4
- 14.a. Summarize carbon clusters, and how do they differ from other carbon structures. CO4K3  
(or)
- 14.b. Illustrate the synthetic process and mechanism of formation of carbon nanotubes? CO4K4
- 15.a. Summarize the uses of nanosensors in biological and medical applications? CO5K4  
(or)
- 15.b. List the applications of metal nanoparticles in the optical and textile industries? CO5K4

**Part C**

**5 x 12 = 60**

**Answer ALL questions**

**Each answer should not exceed 800 words or four pages**

- 16.a. Explain the concept of functionalizing nanomaterials and how it enhances their properties. CO1K3  
(or)
- 16.b. Discuss the synthesis and applications of gold and silver nanoparticles. CO1K4
- 17.a. Explain the optical and electronic properties of metal nanoparticles. CO2K3  
(or)
- 17.b. Demonstrate the metal nanoparticles stabilized in sol, glass, and other media? CO2K4
- 18.a. Compare Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) and discuss their limitations. CO3K4  
(or)
- 18.b. Describe the principles of Atomic Force Microscopy (AFM) and its applications. CO3K4
- 19.a. Explain the synthesis, properties, and potential applications of carbon dots. CO4K4  
(or)
- 19.b. Illustrate the properties and importance of carbon nanotubes in modern nanotechnology. CO4K4
- 20.a. Explain how nanoparticles contribute to the development of advanced coatings. CO5K3  
(or)
- 20.b. Describe the use of nanoparticles in energy storage devices and environmental monitoring. CO5K4

\*\*\*\*\*