

(This Question paper contains 2 printed pages)

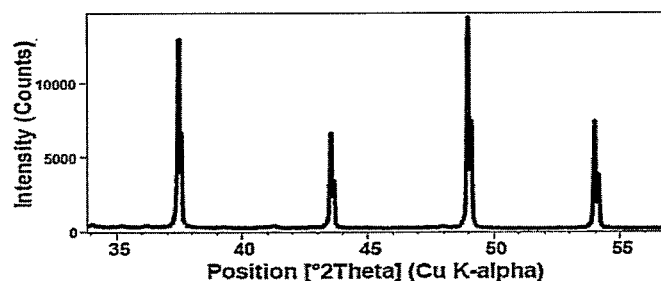
Roll No. _____

S.No. of Question Paper : 7978
Unique Paper Code : 2513010027
Name of the Paper : Nanomaterials Characterization
Name of the Course : B. Sc. (Hons.) Electronics (DSE)
Semester : VII
Duration : 3 Hours
Maximum Marks : 90

Instruction for Candidates

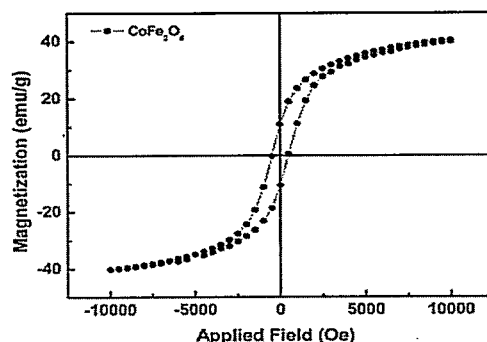
1. Write your Roll No. on the top immediately on receipt of this question paper.
 2. There are **seven** questions in all, out of which you have to attempt any **five** questions.
 3. **First** question is Compulsory.
 4. **All** questions carry equal marks.
 5. Use of Scientific Calculator is allowed.
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1. (a) What are the characteristic properties of materials in the nanoscale? 3
(b) List any three disciplines involved in nanotechnology and explain why the field is interdisciplinary. 3
(c) Define atomic scattering factor. 3
(d) What is meant by blue shift in the absorption edge of nanomaterials? 3
(e) What is a microemulsion? Mention its importance in nanomaterial synthesis. 3
(f) List the different biological systems used for nanoparticle synthesis 3
 2. (a) Explain the Bottom-up and Top-down approaches for the synthesis of nanomaterials. 6
(b) Describe the Physical Vapour Deposition (PVD) method with consolidation for synthesizing nanoparticles. 6
(c) Explain the sol-gel process for synthesizing nanoparticles. Discuss the main steps involved in the method. 6
 3. (a) What is Atomic Force Microscopy (AFM)? Discuss the working principle of AFM in three different modes with suitable diagrams and its applications 6
(b) Derive Bragg's law for diffraction of X-rays by crystal planes with the help of a suitable diagram. 6

- (c) The graph given below shows an X-ray Diffraction (XRD) pattern of a crystalline nanomaterial obtained using Cu K- α radiation (For Cu K α $\approx$ 1.5406 Å).



Briefly explain the information that can be extracted from the above graph.

4. (a) Explain the working principle of a Fourier Transform Infrared (FTIR) spectrometer with the help of a schematic diagram. 6
- (b) Explain the Raman effect and discuss the origin of Stokes and anti-Stokes lines. 6
- (c) Describe the working principle and layout of a photoluminescence spectrometer. 6
5. (a) The hysteresis curve obtained for CoFe₂O₄ nanoparticles using Vibrating Sample Magnetometer (VSM) is shown in the figure given below: 6



Briefly explain the information that can be extracted from the above graph.

- (b) Briefly explain the principle and working of the Four-Probe Method with a suitable diagram. 6
- (c) Briefly explain the concept of the Magneto-Optic Kerr Effect (MOKE). 6
6. (a) Describe the working principle of Transmission Electron Microscope (TEM) with appropriate diagram and its application in material characterization. 6
- (b) Explain the plant-mediated synthesis of nanoparticles with its advantages and limitations. 6
- (c) Discuss diffraction pattern for different types of materials such as gases, liquids, amorphous solids, and crystals. 6
7. (a) Explain how luminescence studies help in analyzing the electronic structure of nanomaterials. 6
- (b) Write a short note on the Magnetoresistance. 6
- (c) Explain the working principle and experimental setup of a Vibrating Sample Magnetometer (VSM) with a neat schematic diagram. Discuss how the magnetization of a sample is measured. 6