


| Name: | |  | |
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| Enrolment No: | | | |
| UPES End Semester Examination, December 2024 | | | |
| Programme Name: Integrated BSc-MSc (Physics) | | Semester: VII | |
| Course Name: Nanofabrication and Characterization of Magnetic Nanostructures | | Time: 03 hrs | |
| Course Code: PHYS4007P | | Max. Marks: 100 | |
| Nos. of page(s): 2 | | | |
| Instructions: Use of a scientific calculator is allowed. | | | |
| SECTION A (5Qx4M=20Marks) | | | |
| S. No. | | Marks | CO |
| Q 1 | In a FCC unit cell of Ag Nanoparticles; the lattice parameter is 4.2 Å. Evaluate the surface energy of {100} surface if its bond strength or bond dissociation energy (ϵ) = 160 kJ/mole. | 4 | CO3 |
| Q2 | Describe the concept of magnetic domain walls and their significance in nanomagnetism. | 4 | CO2 |
| Q3 | How does the Giant Magnetoresistance (GMR) effect revolutionize data storage technology? Explain with examples. | 4 | CO1 |
| Q4 | Compare and contrast the magnetic behavior of small particles with that of bulk materials. | 4 | CO1 |
| Q5 | For a nano magnetic material, if χ is measured as 0.05 at 300 K, and E_a is 0.3 eV, calculate the pre-exponential factor (ν). | 4 | CO3 |
| SECTION B (4Qx10M= 40 Marks) | | | |
| Q6 | What are the 0D nanostructures? Derive the Schrödinger equation for 0D nanostructures and estimate the Eigen function and Eigen values. Or What are the 1D nanostructures? Derive the Schrödinger equation for 1D nanostructure and estimate the Eigen function and Eigen values. | 10 | CO3 |
| Q7 | Discuss the Langevin's theory of Diamagnetic materials and estimate the magnetic susceptibility of diamagnetic compounds. | 10 | CO3 |
| Q8 | Apply the photolithography process to develop advanced nano-magnetic materials. What should be the properties of coat, mask, and resist materials for improved patterning in lithography? | 10 | CO4 |
| Q9 | Comprehend the basic concepts, with appropriate diagrams and mathematical expression, of (i) Electron beam lithography and (ii) X-ray lithography. | 10 | CO4 |

SECTION-C
(2Qx20M=40 Marks)

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| Q10 | <p>Why induction method is suitable for measuring the magnetic moment? Propose a combined experimental and theoretical approach, for vibrating sample magnetometer (VSM) technique, to investigate the; (i) change in magnetic flux, (ii) voltage induced in the coils, (iv) magnetic field of a dipole, and (iv) magnetic moment from a typical Nano-magnetic sample.</p> <p>Or</p> <p>How the magneto-optic methods help to evaluate magnetic properties from the Nano-magnetic compounds? Describe the principle and working of MOKE for characterizing the magnetic properties.</p> | 20 | CO3 |
| Q11 | <p>Discuss the X-ray absorption spectroscopy technique and its sections for electronic structure analysis of nano-magnetic materials. Demonstrate the observation of spin moment and orbital moments detections through XMCD technique.</p> | 20 | CO4 |