M. Sc. II Year	MPH-E411	Semester-IV
ELCETIVE PAPER IV/V	PHYSICS OF NANO MATERIALS	

Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
60	**3 Hrs**	**30**	**70**	**100**	**04**

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllbus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Nanostructures & Structural Characterization : History – background – nanoscale in one dimension, two dimensions, three dimensions – Synthesis of oxide nanoparticles (Sol-gel processing), metallic nanoparticles: semiconductor nanoparticles, fabrication of core – shell nanostructures – aerosol synthesis – gas phase synthesis of nanoparticles – Structural characterization – X-ray diffraction – STM, Atomic force microscopy, properties of nano materials.

UNIT II

Carbon Nanotubes : Carbon allotropes – types of carbon nanotubes – graphene sheet to single walled carbon nanotubes – electronic structure of carbon nanotubes – synthesis of carbon nanotubes: electric arc discharge method – laser method – electrolysis – pyrolysis of hydrocarbons – Fluidised bed CVD method – solar production of CNT – purification methods – properties – filling of CNT – fullerene – purification – properties – application of CNT .

UNIT III

Quantum Heterostructures: Introduction – heterostructure – growth of heterostructure: molecular beam epitaxy – metal organic chemical vapour deposition – heterojunction band alignment – quantum well – superlattice – low dimensional system -– doped heterostructures: modulation doping – quantum wells in heterostructures – effective mass theory in heterostructures – application of effective mass theory in quantum wells in heterostructures – optical confinement – application of heterostructures.

UNIT IV

Quantum wires & Quantum dots: Introduction – size effects - preparation of quantum nanostructures – Fermi gas and density of states – calculation of density of states – infrared detector – quantum well lasers – quantum cascade laser – nanowires – production, structure and uses of nanowires – quantum dots: fabrication techniques – electronic properties - application of quantum dots: information storage – infrared photodetector – laser.

UNIT V

Magneto Electronics and Applications of Nano Technology:

Magnetism in nanocrystals – Nanocrystalline soft magnetic materials – Columb blockade – single electron transistor – quantum cellular automata – fabrication – Spintronics – giant magnetoresistance – Quantum Hall effect – Quantum spin Hall effect – fractional quantum Hall effect – application of nanotechnology – medical application of molecular nanotechnology.

BOOKS FOR REFERENCE

1. Optical Properties of Semiconductor Quantum Dots, U. Woggon Springer Verlog.
2. Nanophysics edited by Dr. Sr. Gerardin Jayam.
3. Transport in Semiconductor nanostructure, D. Ferry and S. Goodnick, Cambridge University Press, 1997.
4. Nanotechnology in Carbon Materials, M. S. Dresselhaus and R. Salio .
5. Advanced Magnetic nanostructures, K. P. Awasthi, Cyber Tech Publications,2008.
6. Introduction to Nanotechnology , Charles P. Poole Jr, Frank.J.Owens, Wiley India Pvt. Ltd, 2008.