J.S. University, Shikohabad

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Value Added Course

VAC-188

(RECENT DEVELOPMENT IN NANOTECHNOLOGY)

Faculty of Physics
(2022-23)

	J.S. University, Shikohabad Faculty of Physics	Value Added Course
		AY: 2022-23

(RECENT DEVELOPMENT IN NANOTECHNOLOGY)

Learning Objectives:

- To learn basics of Nanotechnology.
- To recognize the structures and class of nanomaterials.
- To familiarize the properties of nanomaterials.
- To elaborate the importance of nanomaterials.

Duration: 30 Hours. (Theory and Practical)

Perquisites:

Assessment Criteria/ Award of certification:

Participants who secured 90% attendance and secured 80% marks in final quiz shall be awarded the completion of certificate

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Course Outcomes: -

Maximum Exposure has to be given on Practical Oriented

By the end of the course, the students will be able to

1) Interpret the Fundamentals of Nanotechnology.
2) Expert to classified the nanomaterials.
3) Differentiate the nanomaterials on the basis of their properties.
4) Use the nanomaterials in daily life.

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Sr.No	Content	Duration (30 Hrs)
1	Fundamentals of Nanotechnology	06
2	Structures & Classification of Nanomaterials	06
3	Quantum Theory of Nanomaterials Development of Quantum theory of Nanomaterials	06
4	Nanomaterials and properties	06
5	Applications of Nanomaterials	06

SYLLABUS OUTLINE

1. **Module-1**

Fundamentals of Nanotechnology

Introduction to Nano-science and Nano-technology, Nano-scale material, implications for Physics, Chemistry, Engineering & Biology, and Motivation for Nanotechnology study. History & development of Nano-science and Nano-technology with an emphasis on the history of Nano-metals, Chalcogenides& Boron Nitrite, and Carbon Nanomaterials.

2. **Module-2**

Structures & Classification of Nanomaterials

Nano-structures: various types of nano-structures and nano-crystals. Classification: of bulk Nanostructured materials, 0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States Nano-particles, Quantum dots, Nano-wires, Ultra-thin films, Multi-layered materials.

3. **Module-3**

Quantum Theory of Nanomaterials Development of Quantum theory of Nanomaterials

Application of Block functions in Nanomaterials. Quantum Dots: (a) Semiconductor Quantum Dots, (b) Introduction to lasers (c) Quantum Dot lasers (d) Quantum

Cascade lasers, and (e) Quantum Dot optical memory.

4. **Module-2**

Nanomaterials and properties

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO2, CeO2, ZnO) - Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor- Biological system - DNA and RNA - Lipids - Size-dependent properties - Mechanical, Physical and Chemical properties.

5. **Module-5**

Applications of Nanomaterials

Molecular electronics and Nano electronics – Quantum electronic devices - CNT-based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane-based water purification.

References: -

1. C. Bre´chignac P. Houdy M. Lahmani, Nanomaterials and Nanochemistry, Springer Berlin Heidelberg, Germany (2006).
2. Kenneth J. Klabunde, Nanoscale materials in chemistryЛЪ, Wiley Interscience Publications (2001).
3. C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
4. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wiley & Sons, Inc, 2001.
5. C.S.S.R.Kumar, J.Hormes, C.Leuschner, Nanofabrication towards biomedical applications, Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
6. G.Cao, Nanostructures, and Nanomaterials: Synthesis, properties, and applications, Imperial College Press, 2004.

(Name of Faculty)

Course Coordinator

Dr. Pramod Rajput

(Name of ~~Faculty~~) Dean

Academics

Dr. Akhilesh

(Name of Faculty)

Director/Principl e/Dean of Faculty/Depart ment

Dr. B.P.J Chauhan