

DEPARTMENT OF PHYSICS				<i>Certificate Course</i>				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course		Nanomaterials and Nanotechnology	2	2	50	50	100

**Objectives:**

- To make the students understand the basic concepts of nanomaterials and nanotechnology.
- To impart the knowledge on the synthesis of nanomaterials and various characterization techniques employed in analyzing their properties.
- To realize the applications in various technological fields and environment.

**Learning Outcomes:**

1. Enable the students to comprehend the properties of nano materials.
2. Apply the learned knowledge to synthesis nanomaterials and analyse their properties useful for various technological fields.

**UNIT-I:** Nano materials

Definition of nanometer, nanomaterial and nanotechnology-classification of nanomaterials-examples of nano structured materials-increased surface area of nanomaterials.

**UNIT-II:** Synthesis of nanomaterials

Intoduction- sol-gel method-hydrothermal growth-thin film growth-phsicalvapour deposition- chemical vapour deposition.

**UNIT-III:** Nano structure

Introduction-shape and structures of nanomaterials-size effect on shape of materials- size effect on electronic properties-nanorods,nanocone,nano tetra pods, nano particles-nanocombes and nano walls.

**UNIT-IV:** Nano materials characterization techniques

X-ray diffraction and scherrer method- scanning electron microscopy- electron interaction with matter-transmission electron microscopy-atomic force microscopy-diffuse reflectance spectra.

**UNIT-V:** Application of nano technology

Application: Material science-biology and medicine-bio compatibility and toxicity in nanomaterials-energy and environment-magnetic nano particle.

**Books for study:**

1. M.S Ramachandra Rao and shubrasingh,Nano science and nanotechnology,Reprint edition 2014,Wiley publication.

**Sections:**      **Unit-1:** 1.2, 1.3,1.3.1,1.3.2                                      **Unit-2:**4.1,4.4,4.4.1.1,4.4.1.2,4.4.1.3,  
**Unit-3:**5.1,5.2.1,5.2.2,5.2.3,5.2.4      **Unit-4:**8.2,8.3,8.4,8.7,8.12  
**Unit-5:**10.2,10.3,10.3.1,10.4,10.5,10.9.4

**BOOKS FOR REFERENCE:**

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications,2006.
2. Energy Resources: Conventional & Non-Conventional -M.V.R. KoteswaraRao, BSP Publications,2006.
3. Non-conventional Energy Resources -D.S. Chauhan, New AgeInternational.
4. Renewal Energy Technologies: A Practical Guide forBeginners C.S. Solanki-PHI Learning

**Course designers:**

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