AdusumilliGopalakrishnaiah&
Sugarcane Growers Siddharatha Degree
College of Arts and Science
Autonomous College
NAAC 'A' Grade College
Vuyyuru, Krishna (Dt).,Andhra Pradesh-521165

VALUE ADDED COURSE

TITLE: NANO TECHNOLOGY

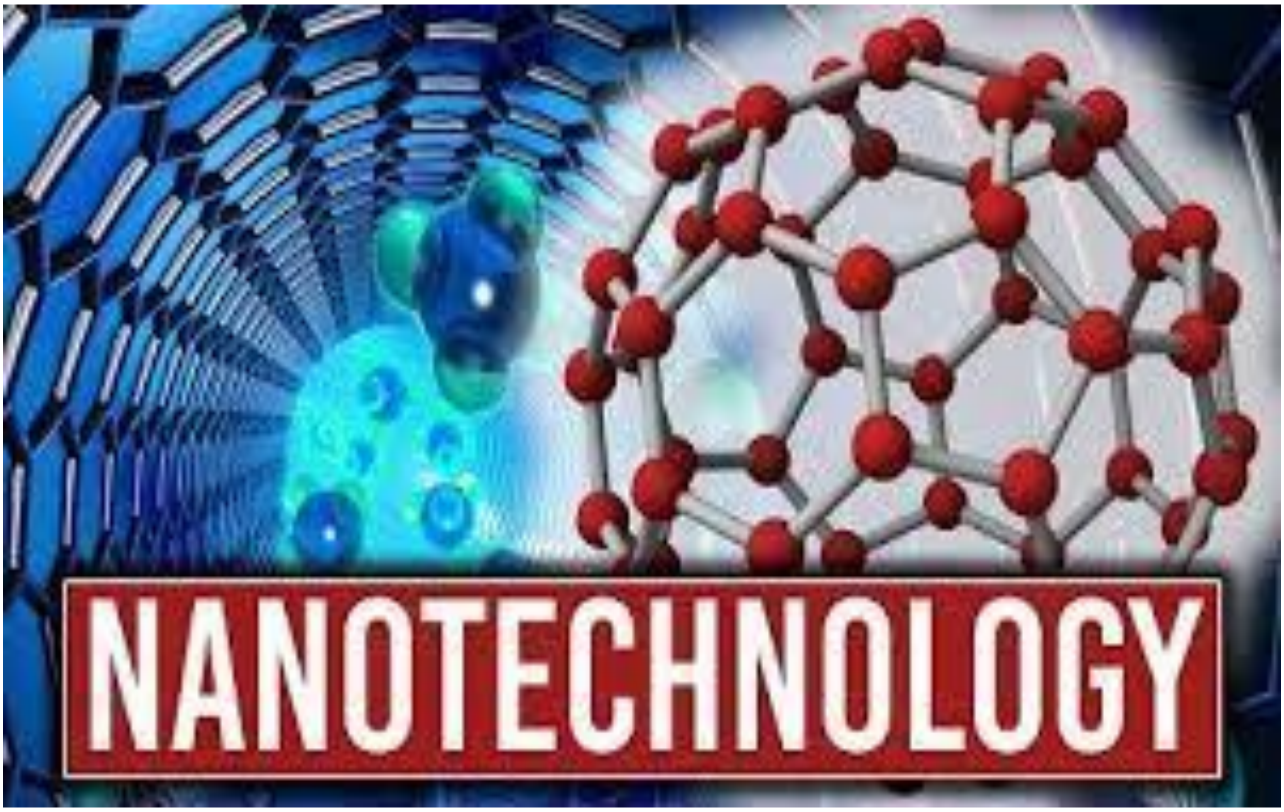
VAC CODE: PHYV4C

On 10th OCT, 2021 TO 10th NOV 2021

Duration of the Course: 30 Days

Organized By

Department of PHYSICS



A.G. & S.G. Siddhartha Degree College of Arts & Science
Vuyyuru-521165, Krishna District, Andhra Pradesh
(Managed by: Siddhartha Academy of General & Technical Education, Vijayawada-10)
An Autonomous College in the Jurisdiction of Krishna University
Accredited by NAAC with "A" Grade

2021- 2022

DEPARTMENT OF PHYSICS

Value Added Course/ Certificate Course

Title: NANO TECHNOLOGY

Name of the Lecturer	:	Smt.M.P.D.Parimala
Class	:	II MPC
Duration of the Course	:	Thirty Days
VAC Code	:	PHYV4C

Objectives: To enable the students to understand the science of nanomaterials.

Methodology :

Teacher-centered Method

Duration: 30 Days

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Value Added Course / Certificate Course

Title: NANO TECHNOLOGY

Date: 10/10/2021 TO 10/11/2021

Date	Content	Module No
10/10/2021TO 16/10/2021	Introduction to Nanoscience, Role of particle size ,Basic concept of quantum well, quantum wire and quantum dot	I
17/10/2021 TO 23/10/2021	Types of Nanomaterials - Nanoclusters, Solid solutions, Thin film, Nanocomposites (Metal Oxide and Polymer based), Core Shell	II
24/10/2021 TO 1/11/2021	Types of nanomaterials	III
2/11/2021 TO 10/11/2021	Applications of nanomaterials	IV

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2021-22

Value Added Course / Certificate Course

Student Enrolment Sheet

Class: II B.Sc , MPC

S. No	Roll No.	Name of the Student	Signature
1	2031401	R.Nandini	R. Nandini
2	2031403	K.Sudheer	K.Sudheer
3	2031407	M.Masheswari	M. Masheswari
4	2031409	E.Alekhya	E. Alekhya
5	2031428	N.Tarun	N. Tarun
6	2031426	K.Venkata Rohit	K. Venkata Rohit
7	2031413	M.Akhil	M. Akhil
8	2031415	I.Manoj Kumar	I. Manoj Kumar.
9	2031417	V.Jyothi	V. Jyothi
10	2031422	K.Supraja	K. Supraja
11	2031425	G.Maneesha	G. Maneesha
12	2031410	J.Priyanka	J. Priyanka
13	2031414	N.Pavan Sai	N. Pavan Sai
14	2031412	SK.Naziya Sulthana	SK. Naziya Sulthana
15	2031418	G.Gopala Krishna	G. Gopala Krishna

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(A. P.)

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Department of Physics

Value Added Course / Certificate Course

Title: NANO TECHNOLOGY

Marks List

Class: II MPC,EM

S. No	Roll No.	Name of the Student	Marks
1	2031401	R.Nandini	10
2	2031403	K.Sudheer	09
3	2031407	M.Masheswari	10
4	2031409	E.Alekhya	10
5	2031428	N.Tarun	10
6	2031426	K.Venkata Rohit	09
7	2031413	M.Akhil	10
8	2031415	I.Manoj Kumar	10
9	2031417	V.Jyothi	09
10	2031422	K.Supraja	10
11	2031425	G.Maneesha	09
12	2031410	J.Priyanka	09
13	2031414	N.Pavan Sai	09
14	2031412	SK.Naziya Sulthana	10
15	2031418	G.Gopala Krishna	08

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Sl.No	Roll No	Student Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	2031401	R.Nandini	P	p	A	p	p	p	p	p	p	p	p	p	p	p	p	14
2	2031403	K.Sudheer	p	p	p	p	p	A	p	p	p	p	p	p	p	p	p	14
3	2031407	M.Masheswari	P	p	p	p	p	p	p	p	A	p	p	p	p	p	p	14
4	2031409	E.Alekhya	P	p	p	p	p	p	A	p	p	p	p	p	p	p	p	14
5	2031428	N.Tarun	P	p	A	p	p	p	p	p	p	p	p	p	p	p	p	14
6	2031426	K.Venkata Rohit	P	p	p	p	p	p	p	p	A	p	p	p	p	p	p	14
7	2031413	M.Akhil	P	p	p	p	p	p	p	p	p	p	A	p	p	p	p	14
8	2031415	I.Manoj Kumar	P	p	p	A	p	p	p	p	p	p	p	p	p	p	p	14
9	2031417	V.Jyothi	P	p	p	p	p	p	p	A	p	p	p	p	p	p	p	14
10	2031422	K.Supraja	P	p	p	p	p	p	p	p	p	p	p	p	A	p	p	14
11	2031425	G.Maneesha	P	A	p	p	p	p	p	p	p	p	p	p	p	p	p	14
12	2031410	J.Priyanka	P	p	p	p	p	A	p	p	p	p	p	p	p	p	p	14
13	2031414	N.Pavan Sai	P	p	p	p	p	p	p	p	p	p	A	p	p	p	p	14
14	2031412	SK.Naziya Sulthana	P	p	p	A	p	p	p	p	p	p	p	p	p	p	p	14
15	2031418	G.Gopala Krishna	P	p	p	p	p	p	p	A	p	p	p	p	p	p	p	14

Value Added Course / Certificate Course - Attendance Register

Class / Section: II B.Sc, MPC Year : IInd Department : physics

Paper: Lecturer:

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Signature of the Lecturer   Signature
of the HOD

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Value Added Course / Certificate Course - Attendance Register

Sl.No	Roll No	Student Name	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	2031401	R.Nandini	P	p	p	p	A	p	p	p	p	p	p	p	p	p	p	14
2	2031403	K.Sudheer	p	p	p	p	p	p	p	p	A	p	p	p	p	p	p	14
3	2031407	M.Masheswari	P	p	A	p	p	p	p	p	p	p	p	p	p	p	p	14
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7	2031413	M.Akhil	P	p	A	p	p	p	p	p	p	p	p	p	p	p	p	14
8	2031415	I.Manoj Kumar	P	p	p	p	p	p	p	A	p	p	p	p	p	p	p	14
9	2031417	V.Jyothi	P	p	p	p	p	p	p	p	p	p	p	A	p	p	p	14
10	2031422	K.Supraja	P	p	p	p	A	p	p	p	p	p	p	p	p	p	p	14
11	2031425	G.Maneesha	P	p	p	p	p	p	p	p	p	p	A	p	p	p	p	14
12	2031410	J.Priyanka	P	p	A	p	p	p	p	p	p	p	p	p	p	p	p	14
13	2031414	N.Pavan Sai	P	p	p	p	p	p	p	A	p	p	p	p	p	p	p	14
14	2031412	SK.Naziya Sulthana	P	p	p	p	p	p	p	p	p	p	A	p	p	p	p	14
15	2031418	G.Gopala Krishna	P	p	p	p	p	p	A	p	p	p	p	p	p	p	p	14

Class / Section: II B.Sc, MPC   Year : IInd   Department : Physics
Paper: Lecturer:

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Department of Physics

Value Added Course / Certificate Course

Title: NANO TECHNOLOGY

Feed Back Form

Name of the Student: K. Sudheer

Class and Roll Number: 2031402

11. Is the programme interested to you (Yes/No)

12. Have you attended all the session (Yes/No)

13. Is the content of the program is adequate (Yes/No)

14. Have the teacher covered the entire syllabus? (Yes/No)

15. Is the number of hours adequate? (Yes/No)

6. Do you have any suggestions for enhancing or reducing the number of weeks designed for the program? (Yes/No)

9. On the whole, is the program useful in terms of enriching your knowledge? (Yes/No)

8. Do you have any suggestions on the program? (Yes/No)

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Department of Physics 2021 - 2022

Value Added Course / Certificate Course

Title: NANO TECHNOLOGY

Feed Back Form

Name of the Student: R. Nandini

Class and Roll Number: 2031401

11. Is the programme interested to you (Yes/No)

12. Have you attended all the session (Yes/No)

13. Is the content of the program is adequate (Yes/No)

14. Have the teacher covered the entire syllabus? (Yes/No)

15. Is the number of hours adequate? (Yes/No)

6. Do you have any suggestions for enhancing or reducing the number of weeks designed for the program? (Yes/No)

9. On the whole, is the program useful in terms of enriching your knowledge? (Yes/No)

8. Do you have any suggestions on the program? (Yes/No)

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Value Added Course / Certificate Course

Title : NANO TECHNOLOGY

Test Exercise:

1. Which one of the following is an example for semiconducting nanowires?

2). The absorption and adsorption of molecules are fast and high in _________________ materials?

3). Which one of the following is an example for thermal properties of nanostructure?

4). Who built the first molecular motor based on CNT?

5). Which one of the following is an example for electrical properties of nanostructure?

6). Which one of the following used in solar cells?

7). What is the standard form of SEM?

8)The diameter of the hair can be measured in terms of _____________ meters?

9) The nanostructures are categorized into ______________ types according to their dimensions?

10) Who first produced nanostructured materials?

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Value Added Course / Certificate Course

Title: NANO TECHNOLOGY

Key:

1.Silicon

2.nanomaterials

3.melting temperature

4. Alex Zettl

5. Tunnelling current

6. Carbon nanotubes

7. Scanning Electron Microscope

8. 100 micro

9.three

10. H. Gleiter

4) NANO TECHNOLOGY

Module No -1

The prefix “Nano” is derived from the Greek word which means “Dwarf”. • One nanometer is equal to one billionth of meter (10-9)

• Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications

At the nanoscale, the physical, chemical, and biological properties of materials differ in fundamental and valuable ways from the properties of individual atoms and molecules or bulk matter.

Nanoscale science and technology i.e. Nanotechnology is a young and burgeoning field that encompasses nearly every discipline of science and engineering. • Nanotechnology is truly a multidisciplinary, interdisciplinary and multifunctional field. Today, chemists, physicists, medical doctors, engineers, biologists and computer scientists are working and collaborating for the development of Nanotechnology

At very small sizes physical properties (magnetic, electric and optical) of materials can change dramatically.

The power of nanotechnology is rooted in its potential to transform and revolutionize multiple technology and industry sectors, including aerospace, agriculture, biotechnology, homeland security and national defense, energy, environmental improvement, information technology, medicine, and transportation. Discovery in some of these areas has advanced to the point where it is now possible to identify applications that will impact the world we live in.

Nanotechnologies can be:

• Top-down:

• Etching a block of material down to the desired shape

• Chips and processors

• Bottom-up:

• Building materials atom by atom.

• Nanoparticles such as C60, carbon nanotubes, quantum dots

Instead of ‘top down’ approach, Feynman visualized that the better way of miniaturization was the ‘bottom up’ alternative and thereby proposed the manipulation of individual atoms and molecules to make new small structures including molecular computers

Is defined as any material that has unique or novel properties, due to the nanoscale (nano metre- scale) structuring. • These are formed by incorporation or structuring of nanoparticles. • They are subdivided into nanocrystals, nano powders, and nanotubes: A sequence of nanoscale of C60 atoms arranged in a long thin cylindrical structure.

Nanomaterial properties can be 'tuned' by varying the size of the particle (e.g. changing the fluorescence colour so a particle can be identified)

<u>Module No -2</u>

Zero dimensional nanomaterials:

• Materials wherein all the dimensions are measured within the nanoscale

• The most common representation of zero dimensional nanomaterilas are nano dots

One dimensional nanomaterials :

• One dimension is outside the nanoscale and other two dimensions are in the nanoscale

• This leads to needle like-shaped nanomaterials

• 1-D materials include nanotubes, nanorods and nanowires.

• 1-D nanomaterials can be

• Amorphous or crystalline

• Single crystalline or poly crystalline

• Chemically pure or impure

• Metallic, ceramic or polymeric.

Two dimensional materials:

• One dimension lies in the nanometer range and other two dimensions are not confined to the nanoscale

• 2D nanomaterials exhibit plate like shapes

• Two dimensional nanomaterials include nanofilms, nanlayers and nanocoatings

Three dimensional materials:

• Three dimensional materials are not confined in the nanoscale in any dimension. These materials are thus characterized by having three arbitrarily dimensions above 100nm

• Materials possess a nanocrystalline structure or involve the presence of features at the nanoscale.

Quantum effects:

• The overall behavior of bulk crystalline materials changes when the dimensions are reduced to the nanoscale.

• For 0-D nanomaterials, where all the dimensions are at the nanoscale, an electron is confined in 3D space. No electron delocalization (freedom to move) occurs.

• Fr 1D nanomaterials, electron confinement occurs in 2D whereas delocalization takes place along the long axis of then nanowirenanorod/nanotube

• In the case of 2D nanomaterials, the conduction electrons will be confined across the thickness but delocalized in the plane of the sheet.

Electrons confinement:

• For 0D nanomaterials the electrons are fully confined.

• For 3D nanomaterials the electrons are fully delocalized

• In 1D and 2D nanomaterials, electron confinement and delocalization coexist.

• The effect of confinement on the resulting energy states can be calculated by quantum mechanics as the particle in the box problem.

A electron is considered to exist inside of an infinitely deep potential well from which it cannot escape and is confined by the dimensions of the nanostructure.

nanomaterials are again organized into four types as follows:

(i) Carbon based material

(ii) Metal based materials

(iii) Dendrimers

(iv) Composites

(i) Carbon based materials:

These are composed of carbon, taking the form of hollow spheres, ellipsoids or tubes. The spherical and ellipsoidal forms are referred as fullerenes, while cylindrical forms are called nanotubes.

(ii) Metal based materials:

These include quantum dots, nanogold, nanosilver and metal oxides like TiO2. A quantum dot is a closely packed semiconductor crystal comprised of hundreds or thousands of atoms, whose size is on the order of a few nanometers to a few hundred nanometers.

(iii) Dendrimers:

Dendrimers are repetitively branched molecules. The name comes from the Greek word 'dendron' (tree). These nanomaterials are nanosized polymers built from branched units. The surface of a dendrimer has numerous chain ends, which can perform specific chemical functions.

Dendrimers are used in molecular recognition, nanosensing, light harvesting, and opto-electrochemical devices. They may be useful for drug delivery.

(iv) Composites:

Composites are combination of nanoparticles with other nanoparticles or with larger, bulk-type materials. Nanoparticles like nanosized clays are added to products (auto parts, packaging materials, etc.) to enhance mechanical, thermal, and flame-retardant properties

<u>Module No - 3</u>

NANOWIRES:

These are defined as the structures which have the diameters of the order of a nanometre and an unconstrained length. i.e., nanowires are much longer than their diameters.

These are also called quantum wires because at this scale they have different quantum mechanical effects. There are different types of nanowires.

For example: carbon nanowires, molecular nanowires, metallic nanowires, etc.

Applications They are useful in digital computing. These are used for the preparation of active electronic components like p-n junction, logic gates, etc.

They have potential applications in high-density data storage. Silver chloride nanowires are used as photocatalysts to decompose organic molecules in polluted water.

QUANTUM DOTS :

Quantum dots (QDs) were first discovered by A. Ekimov in glass matrix and by L. Brus in colloidal solutions (Fig. 7). These are the semiconductor nanoparticles between 10 and 100 atoms in diameter. The properties of QDs can vary depending on its shape and size.

These are not all uniform. In spite of having a variety of applications, QDs are a source of toxic compounds containing in their core. The QDs toxicity may be due to the leaching of toxic heavy metals from the colloid form.

The toxicity may also be originated from intrinsic properties of the size and surface chemistry of quantum dots. Such materials might have potential risks to human health but still the use of these materials is growing quickly

Applications:

These are used in transistors, solar cells, diode lasers, LEDs, etc.

These may increase the efficiency of silicon photovoltaic cells. These are also significant for optical applications like amplifiers, biological sensors, etc.

These are used as photocatalysts. They have potential applications in spectroscopy and fluorescent biomedical imaging

NANOCLUSTURE

It is the grouping of a number of nanoparticles

in a narrow size distribution having at least one-dimension between 1 and 10 nm. Simply, they are fine aggregates of atoms or molecules.

Nanoclustures contain a couple of hundred atoms but the larger aggregates may have more than 1000 atoms (called nanoparticles). The number of atoms in the clusters of critical size with higher stability is called magic number. The nanoclustures are bridge between bulk materials and atomic or molecular structures

Applications:

A bulk material has constant physical properties but at the nanoscale, it has many properties.

It is used in biotechnology and pharmacology.

It has potential applications in microelectronics, telecommunications, sensors, transducers, electroluminescent displays, catalysis, etc.

THINFILMS:

A thin film is a layer of material ranging from fractions of a nanometer (monolayer) to several micrometers in thickness. The controlled synthesis of materials as thin films (a process referred to as deposition) is a fundamental step in many applications.

1.MechanicalThinFilms

Mechanical thin films are unique thin films typically composed of hard, corrosion, and wear-resistant materials. In coating applications, thin mechanical films can be applied to virtually any surface—metals, plastics, glass, and so on—to provide additional strength against friction and abrasion. They also offer superior anticorrosive protection, thus allowing them to be deployed in various industries and applications, such as aerospace engineering and transportation logistics.

2.OpticalThinFilms

Optical thin films are a coating typically applied to materials to give the desired optical properties. They’re one of the **innovations in the solar energy** sector to make flexible, lightweight, and ecologicallyfriendlysolarpanels.

These specialized coatings can enhance performance, increase reflectivity, or change color, depending onthe underlying layer mix and the protective nature of the film. Any product exposed to sunlight is a potential beneficiary of these unique thin films, as they help guard against ultraviolet radiationandfadingduetothesun’srays.

3.ElectronicThinFilms

Compared to their thicker alternatives,thin films—particularly aluminum, copper, and alloy—offer more versatility in electrical or electronic applications. These thin films provide greater insulation than thick film components, allowing more efficient heat transfer.When used for circuitry purposes, the thin layer increases the sensitivity of sensors while reducing power loss. This attribute makes them highly compatible with various surfaces, such as integrated circuits, insulators, or **semiconductors**.

4.MagneticThinFilms

Magnetic thin films are an alternative to traditional materials for engineering and industrial applications requiring magnetic properties. They are incredibly thin, often measuring less than a single nanometer in width. However, they still feature all of the qualities of regular magnets, specifically attraction and repulsion.

They also offer several advantages, such as resistance to environmental interference and extreme durability. These qualities make them ideal for operation in challenging equipment or long life on consumer products. Different types of magnetic thin films can be used in electronics, data storage devices such as memory disks, sensing equipment, and automation systems.

5.ThermalThinFilms

Thermal thin films, also known as insulating thin films, are used in several industries to aid insulation, heat dissipation, and electrical resistance. These films are engineered from polymers with high-performance thermal characteristics and special additives that increase their resistance to thermal cyclingandotherextremeconditions.

Thermal thin films can also be applied without adhesives or fabrics for increased flexibility and faster application times. Thermal thin films create insulation layers that offer better airtight seals than other materials and consume lesser power than typical insulating materials. This makes them incredibly valuableforindustrialapplications.

6.ChemicalThinFilms

Chemical thin films are among the most interesting and complex materials in modern industry. These films form a wide range of encouraging qualities, from corrosion-resistant coatings to electrical conductivityandopticallyactivematerials.

Even simple products can benefit from added durability due to chemical thin films' protection. Combining various components makes it possible to achieve customized compositions unique to the situation. With more research unfolding every day, chemical thin films provide a limitless number of creative possibilities for engineers and manufacturers alike.

Nanocomposites:

Nanocomposites are those composites in which one phase has nanoscale morphology like nanoparticles, nanotubes, or lamellar nanostructure. They have multiphases, so are multiphasic materials, at least of the phases should have dimensions in the range of 10–100 nm.

Nanocomposites are materials that have a solid structure in which the distance between the phases is leastwise formed of a dimension with nanoscale size and general form of an inorganic matrix set in the organic phase, or vice versa, from an organic matrix set in the inorganic phase.

The three types of nanocomposites based on their matrix are ceramic matrix nanocomposite CMNC, polymer matrix nanocomposites PMNC and metal matrix nanocomposites MMNC

The important advantages of polymer nanocomposites are due to increased stiffness, increased resistance to fire, increased thermal and dimensional stability, good optical properties, and improved barrier effect.

Core–shell:

Core–shell type nanoparticles are a type of biphasic materials which have an inner core structure and an outer shell made of different components. These particles have been of interest as they can exhibit unique properties arising from the combination of core and shell material, geometry, and design

The core/shell type nanoparticles can be broadly defined as comprising a core (inner material) and a shell (outer layer material). close interaction, including

- inorganic/inorganic, inorganic/organic,
- organic/inorganic, and
- organic/organic materials.

The electroactive materials applied in the core/shell structure include carbon materials, conducting polymers, metals, metal hydroxides, metal oxides and metal sulfides, while zero-dimensional, one-dimensional, two-dimensional, and three-dimensional structures are considered for the core/shell material.

The core/shell nanoparticles are mainly designed for biomedical applications based on the surface chemistry, which increases its affinity to bind with drugs, receptors, ligands, etc . This has led to the synthesis of novel nanoparticles, which in sync with the biological system, compared to bulk material.

Module No -4

APPLICATIONS OF NANOTECHNOLOGY:

Nanotechnology and nanomaterials can be applied in all kinds of industrial sectors. They are usually found in these areas:

Electronics

Carbon nanotubes are close to replacing silicon as a material for making smaller, faster and more efficient microchips and devices, as well as lighter, more conductive and stronger quantum nanowires. Graphene's properties make it an ideal candidate for the development of flexible touchscreens.

Energy

A new semiconductor developed by Kyoto University makes it possible to manufacture solar panels that double the amount of sunlight converted into electricity. Nanotechnology also lowers costs, produces stronger and lighter wind turbines, improves fuel efficiency and, thanks to the thermal insulation of some nanocomponents, can save energy.

Biomedicine

The properties of some nanomaterials make them ideal for improving early diagnosis and treatment of neurodegenerative diseases or cancer. They are able to attack cancer cells selectively without harming other healthy cells. Some nanoparticles have also been used to enhance pharmaceutical products such as sunscreen.

Environment

Air purification with ions, wastewater purification with nanobubbles or nanofiltration systems for heavy metals are some of its environmentally-friendly applications. Nanocatalysts are also available to make chemical reactions more efficient and less polluting.

Food

In this field, nanobiosensors could be used to detect the presence of pathogens in food or nanocomposites to improve food production by increasing mechanical and thermal resistance and decreasing oxygen transfer in packaged products.

Textile

Nanotechnology makes it possible to develop smart fabrics that don't stain nor wrinkle, as well as stronger, lighter and more durable materials to make motorcycle helmets or sports equipment.

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(AUTONOMOUS) VUYYURU A.P
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Department of Physics

VALUE ADDED COURSE: ***NANO TECHNOLOGY***

CERTIFICATE

This is to Certify that . Son/Daughter of Shri/Smt

has Successfully completed value added course in ***NANO TECHNOLOGY***
Conducted by the Department of Physics from 10-10-2021 to 10-11-2021 .We wish him/her bright future

Co-ordinator *Head of Department* *Principal*