ILLUMINATE 2024

Issue 04

DWARAKA DOSS GOVERDHAN DOSS
VAISHNAV COLLEGE (SHIFT-II)

# ILLUMINATE

## AN UNENDING QUEST FOR KNOWLEDGE

Issue 04

2024

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NANOPHYSICS

**FUNDAMENTAL AND APPLIED ASPECTS OF PHYSICS AT THE NANOSCALE**

POST GRADUATE DEPARTMENT OF PHYSICS

## CREDITS

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**Dwaraka Doss Goverdhan Doss Vaishnav College**

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# ILLUMINATE 2024

The Annual Magazine (Issue 4)

# NanoPhysics

**A Student–Teacher Initiative**

*Published by*

**PG DEPARTMENT OF PHYSICS**

**DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE (Shift II)**
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*Cover page designed by* J Johnmilton, MSc Physics (Batch: 2023–2025)

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**Dr. Ashok Kumar Mundhra**
**Secretary**

## A note from the Secretary's Desk

***"The beautiful thing about learning is that no one can take it away from you."***

It gives me immense pleasure to extend my heartfelt congratulations to the Department of Physics for launching this magazine dedicated to Nanophysics. This initiative is a testament to the department's commitment to fostering scientific curiosity and academic excellence.

More importantly, it provides students a unique opportunity to engage in scientific writing, critical thinking, and intellectual discourse—skills that will benefit them throughout their careers.

This magazine allows students to explore complex ideas, articulate their understanding, and communicate their insights effectively. It enhances their scientific knowledge and sharpens their ability to analyze, innovate, and contribute meaningfully to the ever-evolving world of science.

I take this opportunity to commend and congratulate the students who have contributed their thoughts, research, and perspectives to this publication. I extend my appreciation to the faculty members and the editorial team for their dedicated efforts in bringing this magazine to reality. I wish the magazine great success and look forward to seeing it flourish in the years to come.

SECRETARY
Dwaraka Doss Goverdhan Doss
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DIAMOND JUBILEE YEAR 1964-2024

**Dr. S. Santhosh Baboo**, M.Sc., Ph.D.,
Principal

## A note from the Principal's Desk

**"Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world."**

**— Louis Pasteur**

It gives me immense pleasure to hear that the PG Department of Physics has taken this significant step in launching a magazine dedicated to Nanophysics. This initiative is a departmental milestone and also a proud achievement for our college, reflecting our commitment to academic excellence and research-driven education.

The field of Nanophysics is revolutionizing technology, healthcare, and material science, making this magazine a timely and valuable addition to our institution's intellectual landscape.

I wholeheartedly commend the dedication and enthusiasm of the students and faculty who have contributed to this publication. Their efforts in sharing knowledge, presenting research, and fostering scientific curiosity embody the spirit of learning that we cherish at DDGD Vaishnav College.

I am confident that this magazine will inspire many young minds to explore the wonders of science and contribute to future innovations.

Congratulations to the PG Department of Physics and the editorial team for this outstanding accomplishment! I extend my best wishes for the success of this publication and look forward to many more such initiatives in the years to come.

ARUMBAKKAM CHENNAI 600 106

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**Dr. B. Sylaja,**
**Associate Professor & Head i/c**
**PG Department of Physics**

## Note from the HOD's desk

The Post Graduate Department of Physics is proud to present the magazine ILLUMINATE 2024.This magazine is dedicated to provide insights and discover the fascinating world of Nanophysics. With the ongoing technological advancements, the significance of nanoscale research cannot be overstated.

This magazine serves as a testament to our students and faculties for their dedication towards exploring cutting-edge scientific concepts. I extend my hearty congratulations to all the students who have actively contributed to this magazine Illuminate 2024. Their articles, research highlights, and creative insights demonstrate their enthusiasm for learning and their drive for innovation.

Seeing young minds engage with this vital field of Nano Physics is truly inspiring and I am confident that this platform will motivate them to explore scientific frontiers even further. I extend my appreciation to the faculty members and editorial team who have worked tirelessly to make this initiative a reality.

I am confident that this issue will be a valuable resource for all readers, sparking curiosity and nurturing a spirit of scientific exploration. May this magazine inspire new ideas and discoveries in the ever-evolving world of Nanophysics. I wish this publication great success and look forward to many more editions in the future.

Looking forward to ILLUMINATE 2025…….

B Syl

**Dr. B. Sylaja**

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# ARTICLES

# NEUROSCIENCE NANOTECHNOLOGY

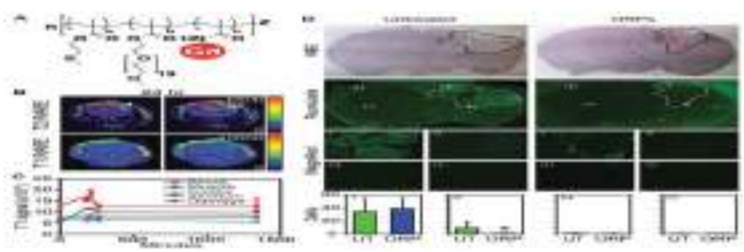
**V Dhivya Dharshini**
**II BSc Physics with Computer Applications**

## Nanomaterials for Neuroprotection

Traumatic brain injury (TBI) is the trauma that affects the brain tissue due to hypoperfusion and hypoxia, which can lead to ischemia and infarction. Reperfusion injury is the damage caused to tissue when the supply of blood returns to the brain after a period of ischemia. These injuries are major epidemiological concerns because they cause significant disability and even death. Neuroprotection refers to the mechanisms or strategies used to slow disease progression by halting or slowing further neuronal loss. Such strategies include mitigating oxidative stress, introducing growth factors, introducing anti-apoptotic peptides, and reducing excitotoxicity and neuroinflammation.

Oxidative stress is thought to be the key neuropathological process contributing to further neuronal loss after CNS insults. One approach to mitigate these effects generally involves the use of nanomaterials loaded with antioxidants, e.g., catalase and superoxide dismutase, its helps eliminate reactive oxygen species (ROS), the culprit of oxidative stress, and its mediated effects such as the inflammatory cascade and neural degeneration. Nanomaterials with antioxidant properties, such as cerium oxide NPs, can also preserve endogenous antioxidant systems.

A nanopolymer-based platform that can react with oxygen known as an oxygen-reactive polymer (ORP) can be used in diagnosis and therapy to reduce the production of ROS in brain trauma. The designed ORP contains mostly PEG by mass to increase the half-life during circulation and biocompatibility. Gadolinium is provided as a contrast agent for magnetic resonance imaging (MRI). By mole, the OPR is mostly a thioether-containing unit used for ROS scavenging. The OPR can scavenge ROS, reduce secondary injury in a controlled cortical impact (CCI) mouse model with TBI, and accumulate in damaged areas of the brain.



To analyse ORP and its therapeutic evaluation in a mouse model of TBI and to prevent further neuronal loss, mechanisms must be installed to prevent cell apoptosis and encourage cell regeneration. This provides a rationale to introduce anti-apoptotic and growth factors to cells. Anti-apoptotic and growth peptides have been shown to be neuroprotective in stroke models. Chitosan NPs loaded with basic fibroblast growth factor (bFGF) and small peptide inhibitor of caspase-3 (z-DEVD-FMK) produced a significant reduction in infarct volume. This reduction was, in part, also due to the functionalization of the nanoparticle with antibodies against the transferrin receptor-1 on the BBB endothelium to enable receptor-mediated transcytosis across the BBB. Taken together, the effects of the added factors demonstrated the usefulness of NPs as a vehicle for the delivery of therapeutics across the BBB for neuroprotection against TBI. Neuroprotection strategies may also be indicated for neurological injury following cardiac surgery, particularly after hypothermic circulatory arrest (HCA). In a canine model, excitotoxicity and neuroinflammation were shown to be the key mediators of post-HCA neurological injury. High doses of valproate confer some degree of neuroprotection but are associated with adverse side effects. It was explored in a Rabbit Model that the use of systemic polyamidoamine (PAMAM) dendrimers conjugated with *N*-acetyl cysteine (NAC), which attenuates neuroinflammation, and with valproate, which attenuates excitotoxicity. Preliminary results showed that the dendrimer conjugates conferred neuroprotection but with improved biodistribution and significantly reduced side effects compared to valproate alone.

Recently, with the development of self-assembling peptide nanofiber scaffolds (SAPNS), a new protective, therapeutic strategy for intracerebral haemorrhage (ICH) has emerged. One study evaluated ICH-related brain injury and functional recovery by observing the effects of hematoma aspiration and intrastriatal administration of RADA16-I. Intracerebral delivery of SAPNS into the haemorrhagic lesion of a rat model of ICH replaced the hematoma and reduced acute brain injury. With SAPNS functioning as a biocompatible material in haemorrhagic brain cavities, the formation of brain cavities was reduced, and an improvement in recovery of sensorimotor function was also observed. The local delivery of SAPNS as a treatment for ICH-related brain injury may allow better repair of ICH brain damage and improved recovery rates. Patients suffering from neurodegenerative diseases may also benefit from neuroprotective strategies utilizing nanomaterials. Alzheimer's disease is a devastating neurodegenerative disease characterized by toxic amyloid beta protein (A$\beta$) aggregates. An interesting neuroprotective technique with the potential to aid the prevention and decrease the progression of Alzheimer's was demonstrated by Kogen et al. in their use of gold nanoparticls (AuNPs). AuNPs linked to the peptide H-Cys-Leu-Pro-Phe-Phe-Asp$NH_2$ (Cys-PEP) were synthesized to allow the NPs to selectively attach to the A$\beta$ aggregates. After conjugation, weak microwave fields were applied to the AuNP system, which in turn absorbed the radiation and released energy. This caused the amyloid aggregates to disaggregate. Given the strong link between A$\beta$ aggregates and Alzheimer's, this method, along with more extensive animal studies, could lead to a very promising neuroprotective strategy to fight this devastating neural disease.

The various strategies available for neuroprotection imply that there is considerable opportunity for the development of different nanomaterial platforms. However, the toxicology profiles of these nanomaterials require greater attention because it is difficult to ascertain if toxic effects are due to the pre-existing pathological processes or the nanomaterial itself.

**NANO PHYSICS: THE FUTURE OF PHYSICS**

**C Nandha Kumaran**

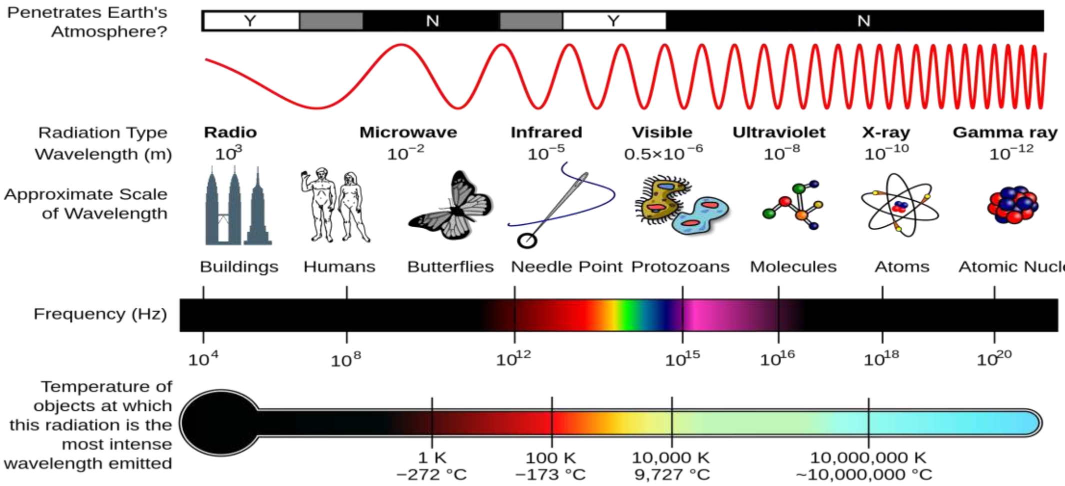
**II BSc Physics with Computer Applications**

Nano physics is a rapidly growing field that is at the intersection of physics, chemistry, and biology. It deals with the study of matter at the nanoscale, which is about 1-100 nanometers in size. This is a very small scale, and it is at this scale that matter exhibits unique properties that are not observed at larger scales.

One of the most important aspects of nano physics is the ability to control the properties of matter at the nanoscale. This can be done by manipulating the arrangement of atoms and molecules. For example, by changing the way that atoms are arranged, it is possible to create materials that are much stronger, lighter, or more conductive than their bulk counterparts.

Nano physics has a major impact on a wide range of fields, including medicine, energy, and electronics. In medicine, nano particles are being used to deliver drugs to specific parts of the body, to image diseases, and to repair damaged tissues. In energy, nano particles are being used to create more efficient solar cells and batteries. And in electronics, nano particles are being used to create smaller, faster, and more powerful computer chips.

The future of nano physics is very bright. As scientists continue to learn more about the properties of matter at the nanoscale, they will be able to create new materials and devices with unprecedented properties. This will have a major impact on our lives, and it will help to solve some of the world's most pressing problems.




Here are some of the specific applications of nano physics in different fields:

Medicine: Nanoparticles are being used to deliver drugs to specific parts of the body, to image diseases, and to repair damaged tissues. For example, nanoparticles can be coated with antibodies that target specific cancer cells. When the nanoparticles are injected into the body, they attach to the cancer cells and deliver a drug that kills them.

Energy: Nanoparticles are being used to create more efficient solar cells and batteries. For example, nanoparticles can be used to absorb more sunlight in solar cells. This makes the solar cells more efficient and allows them to generate more power.

Electronics: Nanoparticles are being used to create smaller, faster, and more powerful computer chips. For example, nanoparticles can be used to create transistors that are much smaller than traditional transistors. This allows computer chips to be made smaller and more powerful.

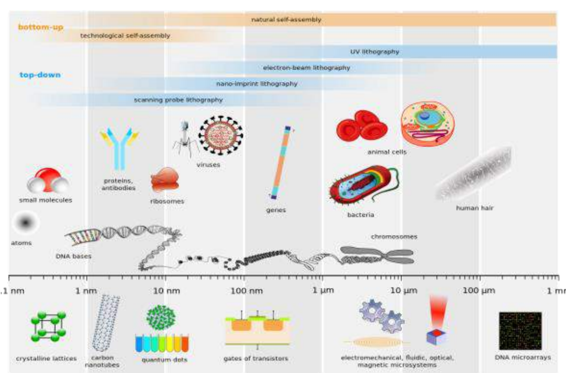
These are just a few of the many applications of nano physics. As the field continues to develop, we can expect to see even more exciting and groundbreaking applications in the years to come.

**The Future of Nano Physics**

The future of nano physics is very bright. As scientists continue to learn more about the properties of matter at the nanoscale, they will be able to create new materials and devices with unprecedented properties. This will have a major impact on our lives, and it will help to solve some of the world's most pressing problems.

For example, nano physicists are working on developing new ways to use nano particles to treat diseases. They are also working on developing new ways to use nano particles to generate energy and to create more efficient electronic devices.

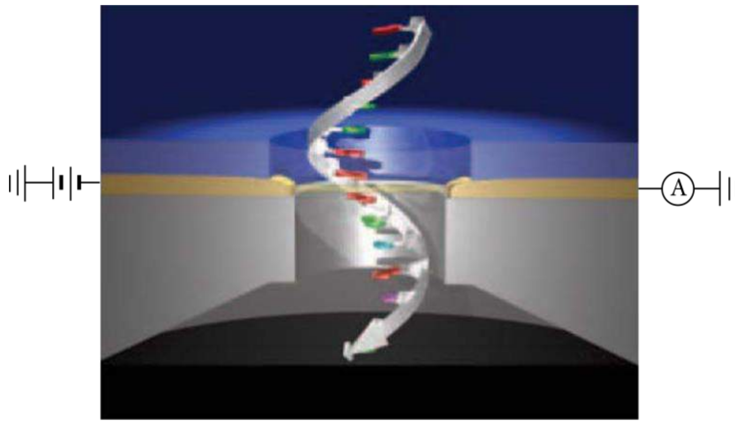
The possibilities are endless. Nano physics is a rapidly growing field, and it is one of the most exciting areas of research today. It is clear that nano physics will have a major impact on our lives in the years to come.




Nanophysics is a branch of physics that deals with the study of objects and phenomena at the nanoscale level. This field has gained a lot of attention in recent years due to its potential applications in various fields like electronics, medicine, energy, and materials science.

Nanophysics deals with the behavior of matter at the nanoscale level, which is typically measured in nanometers ($10^{-9}$ m). At this scale, the properties of matter are significantly different from their bulk counterparts. The fundamental laws of physics that govern the behavior of matter at the macroscopic level are no longer applicable at the nanoscale level.

One of the key features of nanophysics is the development of new materials with unique properties that can be used in various applications. Nanomaterials have properties that are different from their bulk counterparts due to their small size, high surface area to volume ratio, and quantum confinement effects. These properties can be exploited to create new materials with enhanced performance in various applications like energy, electronics, and medicine.




Another area of research in nanophysics is the development of new tools and techniques to study the behavior of matter at the nanoscale level. Scanning Probe Microscopy (SPM) is one such technique that allows researchers to observe and manipulate individual atoms and molecules. Other techniques like Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), and X-ray Diffraction (XRD) are also used extensively in nanophysics research.

In conclusion, nanophysics is a rapidly growing field with the potential to revolutionize various fields like electronics, medicine, energy, and materials science. The unique properties of matter at the nanoscale level can be exploited to create new materials with enhanced performance, and new tools and techniques are being developed to study the behavior of matter at this scale. Nanophysics is an exciting field that holds great promise for the future.

**NANO PHYSICS: PRINCIPLE OF NANOTECHNOLOGY**

**S Sai Manikandan**
**II BSc Physics with Computer Applications**

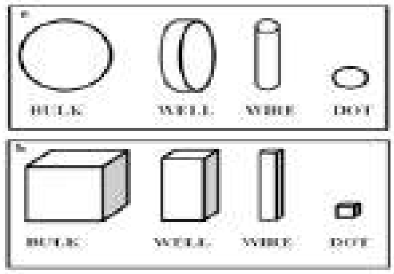
## Introduction

To create a visual image of a nanometer, the width of the human nail in finger is about 10 million nanometers across. To get a sense of some other nano-scaled objects, the diameter of a human hair is between 50,000 and 100,000 nanometers. A head of a pin is about a million nanometers wide and it would take about 10 hydrogen atoms end-to-end to span the length of one nanometer. The length of red blood cell is approximately 7000 nm wide and a water molecule is almost 0.3nm across. It is very small indeed. Nanoscience is a convergence of physics, chemistry, materials science and biology, which deals with the manipulation of materials at atomic, molecular and macromolecular scales; nanotechnology is an emerging engineering discipline that applies methods from nanoscience to create products.


(a) Less than a nanometer, individual atoms are up to a few angstroms, or up to a few tenths of a nanometer, in diameter. (b) Nanometer, ten shoulder-to-shoulder hydrogen atoms. DNA molecules are about 2.5 nanometers wide. (c) A thousand of nanometers, biological cells, like these red blood cells, have diameters in the range of thousands of nanometers.

## Nanomaterials

Nanomaterials have structured components with at least one dimension less than 100nm. Materials that are confined in one dimension i.e., has a nanoscale one dimension (1D; freedom in two dimensions [2D]) like thin film is called 2D quantum well. Materials that are confined in two dimensions i.e., have a two nanoscale dimensions (freedom in 1D) is called 1D nanowires wire. Materials that are confined in three dimensions i.e., has a three nanoscale dimensions (no freedom in any direction or zero dimension) is called zero-dimension quantum dot or nanoparticles. Example precipitates, colloids and quantum dots (tiny particles of semiconductor materials). Nanocrystalline materials, made up of nanometre-sized grains, also fall into this category. Two principal factors cause the properties of nanomaterials to differ significantly from other materials: increased relative surface area, and quantum effects. These factors can change or enhance properties such as reactivity, strength and electrical characteristics. As a particle decreases in size, a greater proportion of atoms are found at the surface compared to those inside. For example, a particle of size 30 nm has 5% of its atoms on its surface, at 10 nm has 20% of its atoms, and at 3 nm has 50% of its atoms. Thus, nanoparticles have a much greater surface area per unit mass compared with larger particles. As growth and catalytic chemical reactions occur at surfaces, this means that a given mass of material in nanoparticulate form will be much more reactive than the same mass of material made up of larger particles.




*(a) Curvilinear and (b) rectangular nanostructures.*

To understand the effect of particle size on surface area, consider a silver coin with 26.96 grams of silver, that has a diameter of about 40 mm, and a total surface area of approximately 27.70 $cm^2$.

**History of Nanotechnology**

1900: Rutherford: discovery of atomic nucleus. Ratio of A/V Surface Area of Cube (A) ($mm^2$) Volume of Cube (V) ($mm^3$) Length of Side of Cube (mm)

1959: Feynman gives after-dinner talk describing molecular machines building with atomic precision "There is plenty of room at the bottom". 1969: Invention of Surface Forces Apparatus (SFA). 1974: Taniguchi uses term "nano-technology". 1977: Drexler originates molecular nanotechnology concepts at MIT. Nanotechnology and nanoscience got started in the early 1980s with two major developments; the birth of cluster science and the invention of the scanning tunneling microscope (STM). The scanning Tunneling Microscope (STM) was invented in 1982.

**Conclusion**

1. Nanosynthesis: making nanoscale building blocks including nanoparticles, nanotubes, and nanostructures
2. Nanofabrication and nanoprocessing: manipulating and processing nanoscale building blocks for a desired purpose
3. Nanoincorporation: incorporating nanoscale building blocks into final product forms including polymer composites, electronic materials, and biomedical devices.
4. Nanocharacterization: measuring and characterizing the basic properties of nanoscale building blocks or final product forms as well as in manufacturing processes.

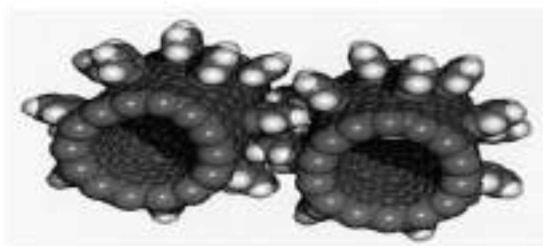
**NANO PARTICLES AND NANO TECHNOLOGY**

**K Dinesh Kumar**
**II BSc Physics with Computer Applications**

## Introduction

Nanotechnology, often shortened to nanotech, is the use of matter on atomic, molecular, and supramolecular scales for industrial purposes. The earliest, widespread description of nanotechnology referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. A more generalized description of nanotechnology was subsequently established by the National Nanotechnology Initiative, which defined nanotechnology as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers (nm). This definition reflects the fact that quantum mechanical effects are important at this quantum-realm scale, and so the definition shifted from a particular technological goal to a research category inclusive of all types of research and technologies that dealt with the special properties of matter which occur below the given size threshold. It is therefore common to see the plural form "nanotechnologies" as well as "nanoscale technologies" to refer to the broad range of research and applications whose common trait is size.

**Uses of Nanotechnology**

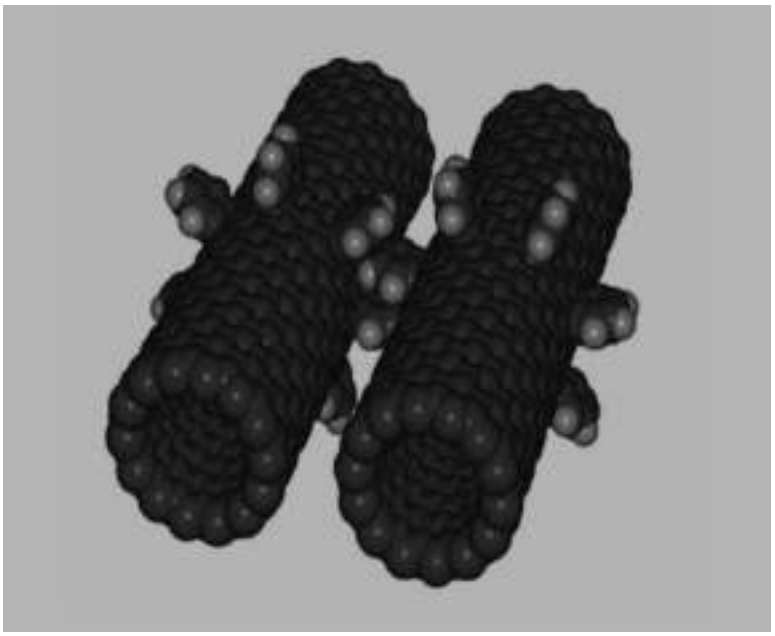


Nanotechnology as defined by size is naturally broad, including fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, energy storage, engineering, microfabrication, and molecular engineering. The associated research and applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale.

Scientists currently debate the future implications of nanotechnology. Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as in nanomedicine, nanoelectronics, biomaterials energy production, and consumer products. On the other hand, nanotechnology raises many of the same issues as any new technology, including concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics, as well as speculation about various doomsday scenarios. These concerns have led to a debate among advocacy groups and governments on whether special regulation of nanotechnology is warranted.

**Uses of Fullerenes of Nanogears**

Fullerenes (C60) are being investigated for their potential use as a drug-delivery system for cancer, AIDS and other diseases. A long-term objective of nanotechnology is to build nano-sized machines which can be inserted into the human body in order to detect and repair diseased cells is a real possibility. Current research however, is only at the primitive levels designing simple components e.g., a carbon nanotube-based gears (below). For more details see 11th Foresight Conference on Molecular Nanotechnology.



**Conclusion**

Bionics or biomimicry seeks to apply biological methods and systems found in nature, to the study and design engineering systems and modern technology. Biomineralization is one example of the systems studied.

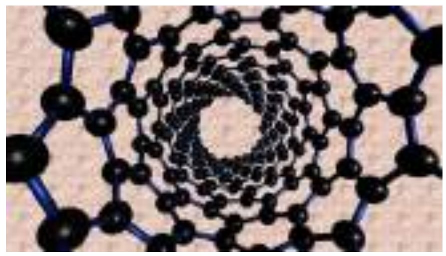
Bionanotechnology is the use of biomolecules for applications in nanotechnology, including use of viruses and lipid assemblies. Nanocellulose, a nanopolymer often used for bulk-scale applications, is a green material that has gained interests in nanotechnology and green chemistry owing to its useful properties such as abundance, high aspect ratio, good mechanical properties, renewability, and biocompatibility.

# NANO PHYSICS UNVEILED

**B Navanesh**
**II BSc Physics with Computer Applications**

## Introduction

Nano physics, a branch of physics that explores the behavior of matter at the nanoscale, has revolutionized our understanding of the physical world. At this extraordinary level, the laws of classical physics give way to quantum mechanics, and materials exhibit unique properties that can be harnessed for numerous applications. In this article, we delve into the captivating world of nano physics, highlighting its significance and the remarkable discoveries it has brought forth.

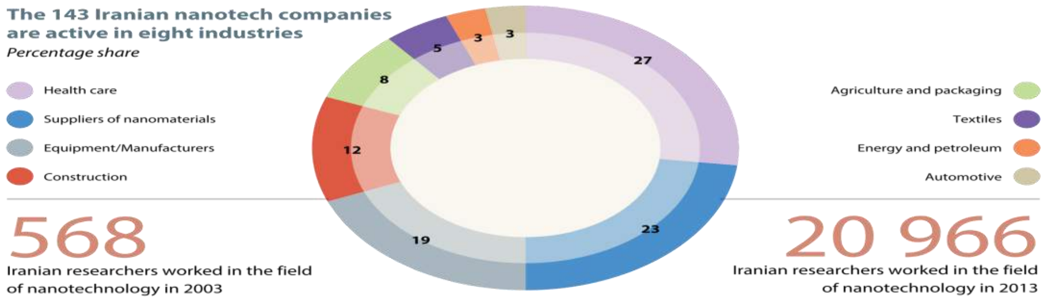


## The Nanoscale: A World of Wonders

The nanoscale refers to dimensions on the order of a billionth of a meter, where matter displays distinct properties compared to macroscopic objects. At this level, quantum effects dominate, and phenomena such as quantum confinement, tunneling, and wave-particle duality come into play. Researchers have found that manipulating materials at the nanoscale can lead to unprecedented control over their properties, enabling the creation of advanced technologies and materials.

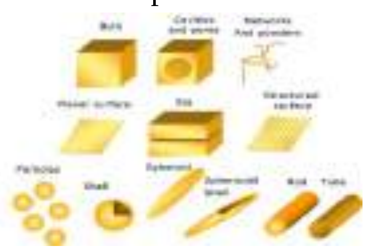
## Quantum Dots and Nanowires

Quantum dots, tiny semiconductor particles just a few nanometers in size, exhibit remarkable properties due to quantum confinement. By controlling their size, shape, and composition, scientists can precisely tune the color of light they emit, making them invaluable for applications in displays, lighting, and medical imaging. Nanowires, on the other hand, are ultra-thin wires with diameters on the nanoscale. These structures possess exceptional electrical and thermal conductivity, paving the way for advancements in electronics and energy conversion.



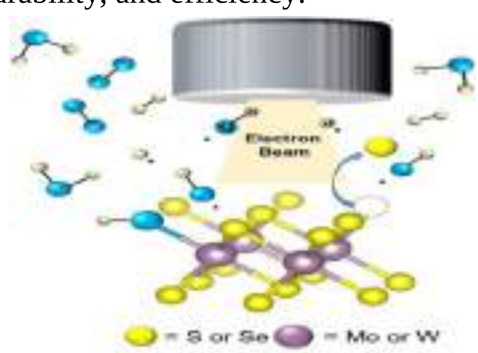

**Nanomedicine and Nanosensors**

Nano physics has also revolutionized the field of medicine. Nanoparticles can be engineered to deliver drugs to specific targets within the body, increasing their effectiveness while minimizing side effects. Furthermore, nanosensors can detect and monitor biological markers at an unprecedented level of sensitivity, opening up new possibilities for early disease detection and personalized medicine.



**Nanotechnology in Everyday Life**

The impact of nano physics extends beyond scientific research laboratories. Nanotechnology has found its way into numerous consumer products, from sunscreens and stain-resistant clothing to high-performance batteries and ultra-strong materials. By harnessing the unique properties of nanomaterials, manufacturers can create products with enhanced functionality, durability, and efficiency.




**Conclusion**

Nano physics has unlocked a new frontier in science, revealing the extraordinary world of the nanoscale. By understanding and manipulating matter at this level, scientists have paved the way for groundbreaking technologies and applications that touch nearly every aspect of our lives. As our knowledge and capabilities in nano physics continue to grow, we can look forward to even more remarkable discoveries and innovations that will shape the future of science, medicine, and technology.

# NANO ENGINEERING IN SCIENCE AND TECNOLOGY

**M Lavanya**
**II BSc Physics with Computer Applications**

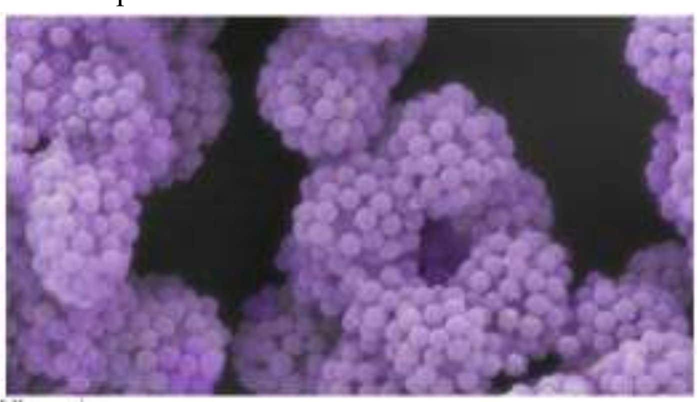
## Nanoengineering

*Nanoengineering* is a branch of engineering that deals with all aspects of the design, building, and use of engines, machines, and structures on the nanoscale. At its core, nanoengineering deals with nanomaterials and how they interact to make useful materials, structures, devices and systems.

Nanoengineering is not exactly a new science, but, rather, an enabling technology with applications in most industries from electronics, to energy, medicine, and biotechnology.

While the term *nanoengineering* is often used synonymously with the more general term *nanotechnology*, the former technically focuses more closely on the engineering aspects of the field, as opposed to the broader science and general technology aspects that are encompassed by the latter.

Other closely related terms used in this context are nanofabrication and nanomanufacturing. One possible approach to distinguish between the terms is by using the criterion of economic viability: The connotations of industrial scale and profitability associated with the word manufacturing imply that nanomanufacturing is an economic activity with industrial production facilities with more or less fully automated assembly lines. By contrast, nanofabrication is more of a research activity based on developing new materials and processes – it's more a domain of skilled craftsmen and not of mass production.



*Tiny particles transformed into 'LEGO-like' modular building blocks. (Image: University of Melbourne.)*

## Nano-Technology and Nano-Science

Nanotechnology and nanoscience are two fields of study concentrating on things at the nanoscale scale. Any studies involving items smaller than a hundred nanometers fall under the purview of nanotechnology or nanoscience. These topics are interdisciplinary, combining information from various disciplines such as physics, chemistry, engineering, and biology.

The ability to observe and manipulate individual atoms and molecules is fundamental to nanoscience and nanotechnology. Particles make up everything on Earth, such as the food we consume, the clothes we wear, the buildings and houses we reside in, and our bodies.

In general, technology refers to applying science to a specific living goal. While science is the objective pursuit of information that improves our understanding of the world, technology implements that knowledge to develop useful objects for everyday living. Nanotechnology, in that meaning, is the implementation of nanoscience.

Technically, there is no distinction. Nanotechnology, often called nanoscience, studies atom or molecule-level material for specific uses. It also addresses the method of creating or manufacturing such materials in connection with the application. A nanometer is one billionth of a meter long, and nanotechnology is focused on imaging, measuring, modeling, and controlling materials on this scale. Nanoscale research, engineering, and technology are all addressed.

Nanoscience and nanotechnology have received worldwide attention as fascinating topics in science and engineering, especially for their possible industrial applications. Both involve examining extremely small objects and can be applied to any other branch of science. Nanoscience and nanotechnologies involve the research and application of very small things, such as nanometer-sized materials.

**What is Nanotechnology?**

Nanotechnology is creating tiny items at the cellular scale using various techniques. Nanotechnology refers to establishing tools and strategies to develop a nanoscale architecture or system that uses molecular properties to be more precise and effective. Nanotechnology concentrates on properties like hardness, lightweight, thermal and electrical conductivity, and responsiveness to develop and produce useful objects using nanotechnology with an understanding of material properties at the nanoscale.

In nanotechnology, there are two approaches known as top-down and bottom-up. Nanotechnology also incorporates ideas such as structure made and molecular machines. Nanotechnology uses man-made and natural materials with sizes less than 100 nm. Nanotechnology has been praised as having the power to improve energy efficiency, help improve the environment, and tackle major health problems. It is believed to be able to massively increase manufacturing output while massively reducing expenses.

Nanotechnology is used in various industries, including computer technology, automobiles, healthcare, textiles, and agriculture. Nanotechnology is expected to be the next industrial revolution, and many countries, institutions, and businesses worldwide are heavily investing in the field of nanotechnology.

Manufacturing field effects circuits with carbon nanotubes is an instance of a nanotechnology application. As a result, objects categorized as nanotechnology are expected to have one or more sizes on the nanometer scale. Nanotechnology is observing, manipulating, detecting, constructing, controlling, and producing materials at the nanometer scale to convert the nanoscience concept to useful daily applications.

**What is Nanoscience?**

The study of objects that have a size of fewer than a hundred nanometers in at least one dimension is defined as nanoscience. When things decrease to the nanometer scale, their behavior changes and the laws that regulate them may no longer remain the same as when they were larger

Nanoscience is focused on determining the underlying rules of these tiny objects, providing conceptual models that describe the behavior of these nanostructured materials, and analyzing their attributes. Nanoscience is the convergence of atomic physics with the physics and chemistry of complicated systems.

How atoms and molecules combine on the nanoscale into larger structures affects important properties of substances, such as electrical, optical, thermodynamic, and mechanical characteristics. Moreover, because quantum state phenomena are important in nanometer-sized objects, these properties often diverge from those on the macroscale. Furthermore, nanomaterials can be used to develop new types of solar panels, fuel cells, and hydro storage systems that can provide renewable energy to developing nations that rely heavily on non-renewable polluting fuels.

# NANOSCIENCE AND NANOTECHNOLOGIES FOR BIOBASED MATERIALS, PACKAGING AND FOOD APPLICATIONS

**B Hariharan**

**II BSc Physics with Computer Applications**

## Introduction

In the past decades, research into nanoscience and nanotechnologies has grown explosively and stimulated a large panel of scientific and technological fields. The boosting effect comes from either the reinvestigation of scientific fields by considering the nanoscale as a relevant level for improving our knowledge or from the extraordinary development of new tools that have democratized access to the nanoscale, such as AFM which is now a routine tool in most labs. This stimulating research has also reached the field of food science and biobased products. The INRA's Science for Food & Bioproducts Engineering division ('CEPIA') has been engaged in this huge challenge, and selected results are presented here. Nanoscience and nanotechnologies involve working with manufacturing to characterize and manipulate materials of nanometer-scale size and can thus have impacts in many fields related to biomass production and transformation for food and non-food applications, from food production to biobased products. In this review, we illustrate the impact of nanoscience and nanotechnologies in three representative fields of applied research developed at INRA's Science for Food & Bioproduct Engineering division. Part one gives examples of the use of biological elements (i.e. polymers or nanoparticles) to build biobased nanomaterials for a better understanding of the biological object. Specific properties of biological macromolecules are described, such as the ability to be specifically hydrolyzed or modified by enzymes, that can be used to engineer innovative materials. Part two covers engineered nanomaterials for food packaging. In the extensive field of nanoscience R&D, food packaging is without a doubt the most active area, as there is better consumer acceptance and regulatory attention for such "out-of-food" applications than "inside" food applications. Wide variety of nanoparticles such as organic/mineral nanospheres, nanotubes or nanosheets is the key factor driving the development of novel engineered nanomaterials (ENM) for food packaging. These innovative ENMs aim to either enhance the functional properties of conventional packaging and/or provide innovative active and 'smart' functionalities, with very special expectations for sustainable bioplastics. Here we focus on overviewing the nanotechnologies used to design innovative and breakthrough functionalities in food packaging areas, and especially safety issues tied to migration from packaging into food. Finally, part three deals with the nanoparticles present in food products. Since the discovery of nanoparticles in food, there has been an attempt to characterize them. The INRA's Science for Food and Bioproduct Engineering division contributed to this effort by analyzing the amount of $TiO_2$ nanoparticles present in some confectioneries, the physicochemical properties of this additive, and the fate of the particles after consumption. Here we describe the steps leading to the identification of this food additive in the coating of sweets and the general properties of food-grade $TiO_2$ in comparison to another source of titanium dioxide. We conclude by briefly explaining what happens to these particles once they have been ingested, including excretion, absorption and bioaccumulation.

**Nanostructured Surfaces and Thin Films of Plant Cell Wall Biopolymers**

Nanostructured surfaces or thin films can be described as a chemically and morphologically-defined deposit of matters which in general present typical dimensions in thickness varying from one to a few hundred nanometers. Surfaces and thin films have long been a focus of research ever since they found applications in many industrial fields, but the advent of nanoscience and nanotechnology has sparked a surge in the number reports and research projects on nanostructured surfaces.

**Nanocomposite Materials for Food Packaging Applications: Improving Functional Properties and Safety Concern**

In the extensive field of nanoscience R&D, food packaging is without a doubt one of the most promising and advanced R&D areas, posting a compound annual growth rate of 12.7% for commercial applications. The development of engineered nanomaterials (ENM) for food packaging applications aims either to enhance the mechanical and barrier properties of conventional or biobased packaging materials and/or provide innovative active and intelligent functionalities.


*Food safety and preservation in nanotechnology*

**Controlling the Presence of the Food Additive Titanium Dioxide and Its Fate After Ingestion**

A range of inorganic additives including titanium dioxide ($TiO_2$) is available for food applications, nutraceuticals and supplements. $TiO_2$ is used as a white pigment in processed foods, as described in the recent EFSA report (EFSA, 2016). $TiO_2$ has been in the spotlight for years, as it is totally exogenous to our organism, has been classified as possibly carcinogenic by inhalation to humans by the International Agency for Research on Cancer (IARC) since 2006, and it may be formed very small

**Conclusion**

Nanotechnology offers promising new possibilities in the agriculture and food industry where it has concrete applications, but there is also a lack of awareness and uncertainty about the balance between potential benefits on one side and potential risks and possible long-term side effects on the other. Consumer perception of health and safety concerns is central to the uptake or rejection of this new technology. The number of questions, not still well taken into account and financed.

**X-RAY DIFFRACTION**

**K Aishwarya**
**II BSc Physics with Computer Applications**

X-ray powder diffraction (XRD) is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. The analyzed material is finely ground, homogenized, and average bulk composition is determined.

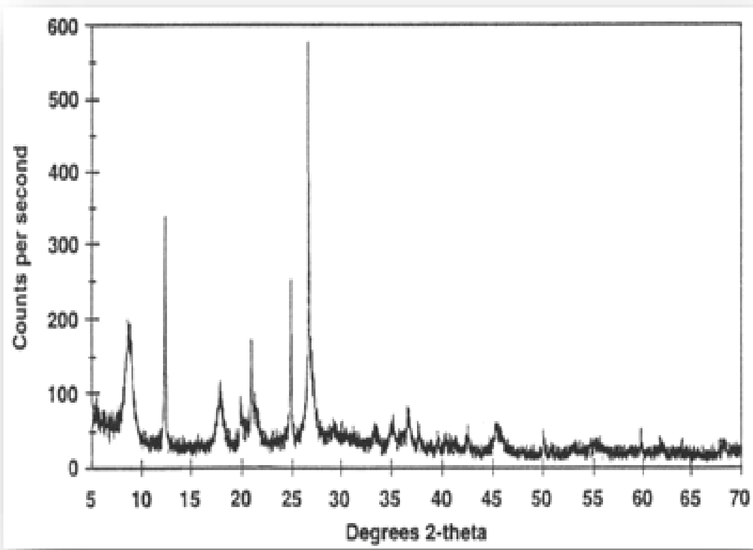
Max von Laue, in 1912, discovered that crystalline substances act as three-dimensional diffraction gratings for X-ray wavelengths similar to the spacing of planes in a crystal lattice. X-ray diffraction is now a common technique for the study of crystal structures and atomic spacing.

X-ray diffraction is based on constructive interference of monochromatic X-rays and a crystalline sample. These X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample. The interaction of the incident rays with the sample produces constructive interference (and a diffracted ray) when conditions satisfy Bragg's law ($n \lambda = 2d \sin \theta$). This law relates the wavelength of electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample. These diffracted X-rays are then detected, processed and counted. By scanning the sample through a range of $2\theta$ angles, all possible diffraction directions of the lattice should be attained due to the random orientation of the powdered material. Conversion of the diffraction peaks to d-spacing and allows identification of the mineral because each mineral has a set of unique d-spacing. Typically, this is achieved by comparison of d-spacing with standard reference patterns.

All diffraction methods are based on generation of X-rays in an X-ray tube. These X-rays are directed at the sample, and the diffracted rays are collected. A key component of all diffraction is the angle between the incident and diffracted rays. Powder and single crystal diffraction vary in instrumentation beyond this .X-ray diffraction meter consist of three basic elements: an X-ray tube, a sample holder, and an X-ray detector.

*Bruker's X-ray Diffractometer*

X-rays are generated in a cathode ray tube by heating a filament to produce electrons, accelerating the electrons toward a target by applying a voltage, and bombarding the target material with electrons. When electrons have sufficient energy to dislodge inner shell electrons of the, the most common being target material, characteristic X-ray spectra are produced. These spectra consist of several components $K_\alpha$ and $K_\beta$. $K_\alpha$ consists, in part, of $K_{\alpha 1}$ and $K_{\alpha 2}$. $K_{\alpha 1}$ has a slightly shorter wavelength and twice the intensity as $K_{\alpha 2}$. The specific wavelengths are characteristic of the target material (Cu, Fe, Mo, Cr). Filtering, by foils or crystal monochrometer, is required to produce monochromatic X-rays needed for diffraction. $K_{\alpha 1}$ and $K_{\alpha 2}$ are sufficiently close in wavelength such that a weighted average of the two is used. Copper is the most common target material for single-crystal diffraction, with $CuK_\alpha$ radiation = 1.5418Å. These X-rays are collimated and directed onto the sample. As the sample and detector are rotated, the intensity of the reflected X-rays is recorded. When the geometry of the incident X-rays impinging the sample satisfies the Bragg Equation, constructive interference occurs and a peak in intensity occurs. A detector records and processes this X-ray signal and converts the signal to a count rate which is then output to a device such as a printer or computer monitor.




*X-ray powder diffractogram*

Peak positions occur where the X-ray beam has been diffracted by the crystal lattice. The unique set of d-spacings derived from this patter can be used to 'fingerprint' the mineral. The geometry of an X-ray diffraction meter is such that the sample rotates in the path of the collimated X-ray beam at an angle θ while the X-ray detector is mounted on an arm to collect the diffracted X-rays and rotates at an angle of 2θ. The instrument used to maintain the angle and rotate the sample is termed a *goniometer*. For typical powder patterns, data is collected at 2θ from ~5° to 70°, angles that are preset in the X-ray scan.

# SEMICONDUCTOR QUANTUM DOTS

**J Pavan Kumar**

**II BSc Physics with Computer Applications**

## Introduction

Semiconductor quantum dots (QDs) are nanoscale material clusters composed of $10^2$–$10^5$ atoms. The size of the QDs is orders of magnitude larger than a typical atomic radius, yet small enough to provide quantum confinement of electrons and holes in all three spatial dimensions. Consequently, they are also referred to as *artificial atoms*. A unique property of the semiconductor QDs is that the energies and wave functions of the quantum confined states can be tailored by controlling their size, shape, and composition.

## Semiconductor QDs

The semiconductor QDs are typically fabricated either by chemical synthesis or epitaxial growth. The chemical fabrication methods have the advantage of being inexpensive, but the epitaxial QDs have several important benefits, including the possibility of direct integration in a high-quality crystalline matrix, which provides high optical quality and enables fabrication of optical and electrical devices exploiting epitaxial heterostructure technology. The most widely explored type of epitaxial semiconductor QDs are the coherently strained epitaxial InAs QDs obtained by Stranski-Krastanov growth on GaAs surfaces.

## Dielectric Microresonators with Colloidal Quantum Dots

Semiconductor quantum dots typically have diameters of a few nanometers, which are two orders of magnitude smaller than the wavelength of visible light. One way to increase the interaction of a quantum dot using a microcavity. Fabrication of pillar microcavities made of semiconductor material and containing self-assembled quantum dots is well established.[20] In contrast, technologies for the implementation of colloidal semiconductor quantum dots into dielectric microcavities had yet to be developed. We have manufactured high-quality pillar resonators with embedded colloidal CdSe/ZnS quantum dots as light emitters by focused ion beam. First, a planar dielectric cavity is formed by two Bragg mirrors, each consisting of sputtered pairs of alternating $TiO_2$ and $SiO_2$ $\lambda/4$ layers. The centre of the cavity hosts colloidal CdSe/ZnS quantum dots that are mixed into liquid polysilazane. After solidification of this layer the dots are embedded in a robust $SiO_2$ layer of $\lambda/2$ thickness. Subsequently, micropillars with diameters in the range of 2.4 μm down to 600 nm are milled out of the planar cavity via FIB. A broadband light transmission measurement through a single micropost resonator showed the lowest cavity mode blue-shifting with decreasing pillar diameters.

## Conclusion

Semiconductor QDs have displayed remarkable optical and electronic properties, which are not seen in any other materials or their bulk counterparts. These properties have been exploited for potential applications in a wide range of fields, such as lighting, solar energy, biomedical imaging, and so on. Since their discovery in the 1980s, they have been studied for applications in photocatalysis. Recent surge in the interest in photocatalytic conversion of $CO_2$ has resulted in a renewed interest in using these optically active materials as sensitizers to enable visible-light photocatalytic activity in wide band-gap catalysts such as $TiO_2$ and ZnO. This chapter illustrates the use of CdSe and PbS QDs-sensitized $TiO_2$ photocatalysts for visible-light $CO_2$ reduction.

# NANOFIBERS: REVOLUTIONIZING MATERIALS AND APPLICATIONS

**D Aswath**

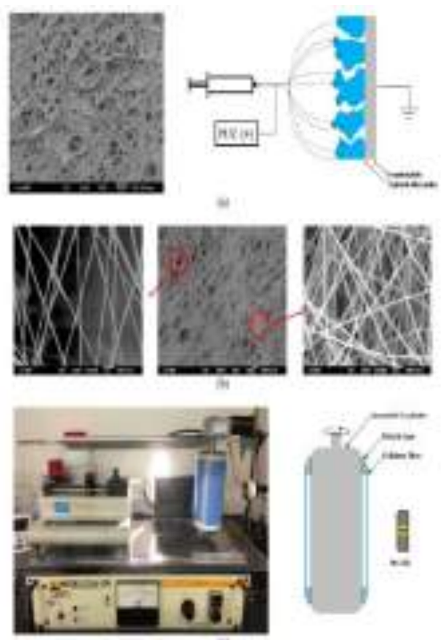
**II BSc Physics with Computer Applications**

## Introduction

Nanofibers are ultrafine fibers with diameters typically ranging from a few nanometers (nm) to a few hundred nanometers. They are created through electrospinning or self-assembly techniques and have unique properties such as a high surface-to-volume ratio, exceptional strength, and customizable characteristics. This article looks at how nanofibers are revolutionizing a variety of industries due to these advantageous properties.

## Nanofibers in Filtration and Air Purification

Nanofibers have become an increasingly popular tool for filtration and air purification, due to their small pore size and large surface area. These features allow for highly efficient removal of many particles and pollutants, even microorganisms, making them much more effective than traditional filters. Consequently, nanofiber-based filters have been used to improve air quality in industrial, indoor, and healthcare settings.



*Nanofibre Filter Performance*

## Nanofibers in Tissue Engineering and Regenerative Medicine

Nanofibers provide a three-dimensional structure for tissue engineering and regenerative medicine, promoting cell adhesion, proliferation, and differentiation. This presents potential for applications in wound healing, organ transplantation, and the repair of damaged tissues.

**Nanofibers in Drug Delivery**

Nanofibers have become an important tool for drug delivery systems due to their high surface area and customizable properties. They can help target drugs to specific areas or cells, leading to more effective treatments with fewer side effects. This technology has vast potential in the treatment of diseases such as cancer, diabetes, and chronic infections.

**Nanofibers in Energy Storage and Conversion**

Nanofibers have various applications in energy storage and conversion, like in battery and supercapacitor electrodes, fuel cells and solar cells. These fibers can increase charge and discharge rates, as well as energy density and durability, and improve energy conversion efficiency.


*Electrospun Nanofibers for New Generation Flexible Energy Storage*

**Nanofibers in Textiles and Wearable Electronics**

Nanofibers have allowed for the creation of new and advanced textiles, including coatings that give water repellency, flame resistance, and antibacterial protection. They have also enabled the development of smart garments capable of monitoring vital signs, responding to environmental changes, and delivering therapeutic interventions.

**Conclusion**

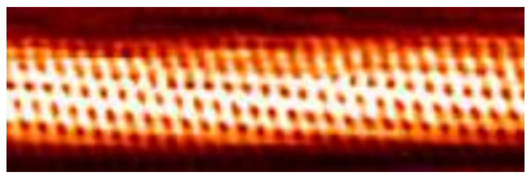
Nanofibers have excellent properties and are applicable to a variety of industries, potentially revolutionizing multiple sectors and improving the quality of life. Research and development in nanotechnology is advancing, allowing for these possibilities.

# CARBON NANOTUBES

**M Kishore Kumar**
**II BSc Physics with Computer Applications**

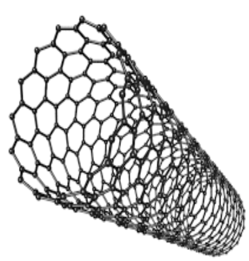
## Introduction

A carbon nanotube (CNT) is a tube made of carbon with a diameter in the nanometer range (nanoscale). They are one of the allotropes of carbon. Carbon nanotubes can exhibit remarkable properties, such as exceptional tensile strength and thermal conductivity because of their nanostructure and strength of the bonds between carbon atoms. Some carbon nanotube structures exhibit high electrical conductivity while others are semiconductors. In addition, they can be chemically modified. These properties are expected to be valuable in many areas of technology, such as electronics, optics, composite materials (replacing or complementing carbon fibers), nanotechnology, and other applications of materials science.



## Functionalization

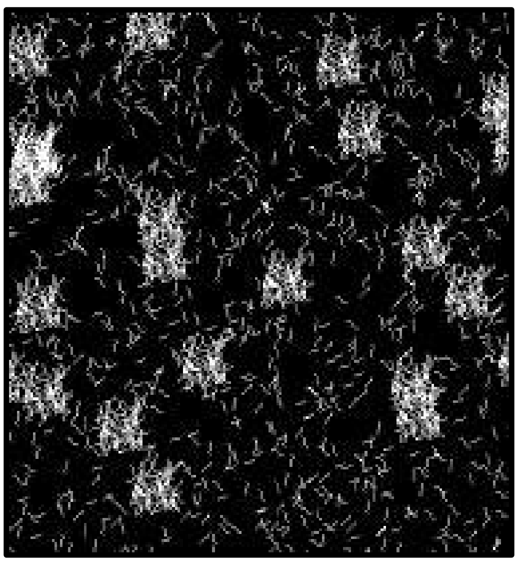
CNTs are known to have weak dispersibility in many solvents such as water as a consequence of strong intermolecular p–p interactions. This hinders the processability of CNTs in industrial applications. In order to tackle the issue, various techniques have been developed to modify the surface of CNTs in order to improve their stability and solubility in water. This enhances the processing and manipulation of insoluble CNTs rendering them useful for synthesizing innovative CNT nanofluids with impressive properties that are tunable for a wide range of applications. Chemical routes such as covalent functionalization have been studied extensively, which involves the oxidation of CNTs via strong acids (e.g., sulfuric acid, nitric acid, or a mixture of both) in order to set the carboxylic groups onto the surface of the CNTs as the final product or for further modification by esterification or amination. Free radical grafting is a promising technique among covalent functionalization methods, in which alkyl or aryl peroxides, substituted anilines, and diazonium salts are used as the starting agents.



*Structure and functionalization of carbon nanotubes*

**Modeling**

Carbon nanotubes are modelled in a similar manner as traditional composites in which a reinforcement phase is surrounded by a matrix phase. Ideal models such as cylindrical, hexagonal and square models are common. The size of the micromechanics model is highly functional in terms of the studied mechanical properties. The concept of representative volume element (RVE) is used to determine the appropriate size and configuration of computer model to replicate the actual behavior of CNT reinforced nanocomposite. Depending on the material property of interest (thermal, electrical, modulus, creep), one RVE might predict the property better than the alternatives. While the implementation of ideal model is computationally efficient, they do not represent microstructural features observed in scanning electron microscopy of actual nanocomposites. To incorporate realistic modeling, computer models are also generated to incorporate variability such as waviness, orientation and agglomeration of multiwall or single wall carbon nanotubes.



**Applications**

Carbon nanotubes are currently used in multiple industrial and consumer applications. These include battery components, polymer composites (to improve the mechanical, thermal and electrical properties of the bulk product, and as a highly absorptive black paint). Many other applications are under development, including field effect transistors for electronics, high-strength fabrics, biosensors for biomedical and agricultural applications, and many others.

**Applications Under Development**

Applications of nanotubes in development in academia and industry include:

1. Utilizing carbon nanotubes as the channel material of carbon nanotube field-effect transistors.
2. Using carbon nanotubes for environmental monitoring due to their active surface area and their ability to absorb gases.

# UNLEASHING THE POTENTIAL OF NANOPARTICLES: EXPLORING THEIR DIVERSE APPLICATIONS

**SU Akshara and GM Gayathri Dhevi**

**II MSc Physics**

**Introduction:** Nanotechnology has revolutionized scientific fields, propelling us into an era of technological advancements. At the core of this revolution lies nanoscience, the study of materials and phenomena at the nanoscale. While nanoparticles' medical applications are well-known, their potential extends beyond healthcare. In this article, we delve into the wide-ranging applications of nanoparticles across various fields, unlocking the possibilities offered by these tiny particles.

1. **Energy Innovations**: Nanoparticles are transforming the energy landscape by enhancing energy generation, storage, and conservation. In solar cells, nanomaterials like quantum dots or perovskites enable higher light absorption and improved efficiency. They also play a pivotal role in developing advanced batteries and fuel cells, offering faster charging, longer lifetimes, and enhanced energy density.

2. **Electronics and Information Technology**: Nanoparticles drive progress in electronics, enabling smaller, faster, and more energy-efficient devices. Nanoscale transistors fabricated with nanoparticles revolutionize the industry. Quantum dots with precise color emission find use in displays and lighting. Nanoscale materials aid in memory devices with improved storage capacity and stability.

3. **Environmental Remediation**: Nanoparticles offer promising solutions to environmental challenges. They effectively remove contaminants from air, water, and soil due to their adsorption and catalytic properties. Engineered nanoparticles trap or degrade heavy metals, organic pollutants, and microplastics, promoting cleaner environments and sustainable ecosystems.

4. **Optics and Photonics Advancements**: Nanoparticles exhibit fascinating optical properties, leading to breakthroughs in photonics. Manipulating light at the nanoscale enables the development of nanostructured coatings, plasmonic devices, and metamaterials. These advancements drive ultra-high-resolution imaging, advanced sensors, and ultrafast communication technologies.
5. **Material Science Innovations**: Nanoscience propels material science, offering enhanced mechanical, thermal, and electrical properties. Nanoparticles reinforce polymers and metals, resulting in lightweight composites with remarkable strength and durability. They find use in heat dissipation materials and advanced thermal management systems.

**Conclusion**: Nanoscience unlocks vast possibilities beyond medical applications. Nanoparticles drive innovation in energy, electronics, environmental remediation, materials, and agriculture. As we explore the nanoworld, nanoparticles' potential in non-medical applications is limited only by imagination and scientific ingenuity. These tiny particles hold the key to cleaner energy, enhanced electronics, sustainable environments, and advanced materials, shaping a future of technological advancements.

# INSTRUMENTS USED IN NANOTECHNOLOGY

**AS Reshma**

**II MSc Physics**

Nanotechnology in essence is the technology based on the manipulation of individual atoms and molecules to build complex structures that have atomic specifications. There are various types of instruments used in Nanotechnology such as microscopes, probes, lithography systems, fabrication systems etc. The scanning probes that are majorly used since the beginning are the Atomic Force Microscope and the Scanning Tunneling Microscope. Atomic force microscopy is also known as Scanning force microscopy. They are used for visualizing, imaging, measuring and for manipulating objects that are in nanoscale. The resolution of such a device is said to be in the fractions of a nanometer. This was developed in the year 1986 by Binnig, Quate and Gerber and they were awarded the noble prize for the same. Scanning Tunneling Microscope (STM)Was developed in the year 1981 by Gerd Binnig and Heinrich Rohrer. They are used for imaging surfaces at the atomic level.

The very first devices that made us possible to see the nanoparticles were the scanning confocal microscope and the scanning acoustic microscope in the years 1961 and 1970. The latest techniques involve a method called position assembly in which the end of a scanning probe is used to make the nanoparticles visible. Some of the other tools that are needed in this field are for the application in nanolithography, a process that is used to reduce a big material to nanosize. Some of the methods that are used for this technique are optical lithography, X-ray lithography, dip pen nanolithography and so on.

# REVOLUTIONIZING MEDICINE: NANOTECHNOLOGY IN CANCER TREATMENT

**G Jeevakumaran**
**II MSc Physics**

**Introduction:** Nanotechnology, the science of manipulating matter at the atomic and molecular scale, is revolutionizing various fields, and one area where it holds immense promise is cancer treatment. With its ability to precisely target cancer cells while sparing healthy tissue, nanotechnology is paving the way for more effective and less invasive therapies. In this article, we explore the breakthroughs and potential applications of nanotechnology in cancer treatment.

**Nanoparticle Drug Delivery Systems:** Nanoparticles are being developed as carriers for targeted drug delivery in cancer treatment. These tiny particles can encapsulate chemotherapy drugs, protecting them during circulation and delivering them directly to cancer cells. By attaching specific molecules to the nanoparticle's surface, they can selectively bind to cancer cells, enhancing drug efficacy while minimizing side effects.

**Nanostructured Materials for Imaging**: Nanotechnology enables the development of advanced imaging techniques for cancer detection and monitoring. Nanostructured materials, such as quantum dots and nanoprobes, possess unique optical properties that allow for highly sensitive and specific imaging of tumors. These materials can provide real-time visualization of cancer cells, aiding in early diagnosis and precise surgical interventions.

**Theranostic Nanoparticles:** Theranostics combines therapy and diagnostics into a single nanoscale platform. Theranostic nanoparticles can simultaneously deliver therapeutic agents and provide real-time monitoring of treatment response. They allow for personalized medicine approaches, where treatment can be tailored based on individual patient needs and real-time feedback.

**Nanosensors for Early Detection:** Nanosensors are being developed to detect cancer biomarkers in body fluids at the earliest stages. These miniature devices can identify specific molecules associated with cancer, offering a non-invasive and highly sensitive means of early detection. Nanosensor technology has potential to revolutionize cancer screening, enabling timely interventions and improving patient outcomes.

**Conclusion**: Nanotechnology is transforming cancer treatment by providing innovative approaches for targeted drug delivery, imaging, early detection, and personalized medicine. The potential impact of nanoscience in improving patient outcomes and reducing the burden of cancer cannot be overstated. As research in this field continues to advance, nanotechnology holds the promise of revolutionizing the way we diagnose, treat, and ultimately prevent cancer.

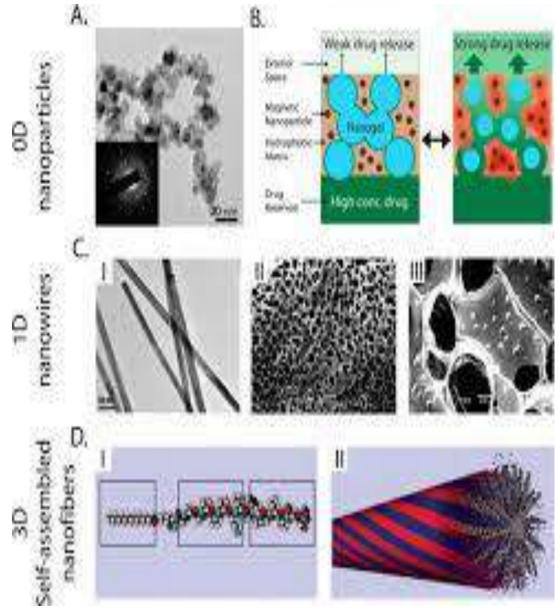
**NANOPARTICLE**

**M Kaviya**

**II MSc Physics**

Nanoparticles are extremely small particles with dimensions typically in the nanometer range, which is one billionth of a meter. They can be composed of various materials, including metals, semiconductors, polymers, or biological substances. Due to their small size, nanoparticles exhibit unique properties and behaviours compared to larger particles of the same material.

Nanotechnology has greatly contributed to major advances in computing and electronics, leading to faster, smaller, and more portable systems that can manage and store larger and larger amounts of information. These continuously evolving applications include:




Transistors, the basic switches that enable all modern computing, have gotten smaller and smaller through nanotechnology. At the turn of the century, a typical transistor was 130 to 250 nanometers in size. In 2014, Intel created a 14 nanometer transistor, then IBM created the first seven nanometer transistor in 2015, and then Lawrence Berkeley National Lab demonstrated a one nanometer transistor in 2016! Smaller, faster, and better transistors may mean that soon your computer's entire memory may be stored on a single tiny chip.

- Using magnetic random access memory (MRAM), computers will be able to "boot" almost instantly. MRAM is enabled by nanometer-scale magnetic tunnel junctions and can quickly and effectively save data during a system shutdown or enable resume-play features.

- Ultra-high definition displays and televisions are now being sold that use quantum dots to produce more vibrant colors while being more energy efficient.

- Flexible, bendable, foldable, rollable, and stretchable electronics are reaching into various sectors and are being integrated into a variety of products, including wearables, medical applications, aerospace applications, and the Internet of Things. Flexible electronics have been developed using, for example, semiconductor nanomembranes for applications in smartphone and e-reader displays. Other nanomaterials like graphene and cellulosic nanomaterials are being used for various types of flexible electronics to enable wearable and "tattoo" sensors, photovoltaics that can be sewn onto clothing, and electronic paper that can be rolled up. Making flat, flexible, lightweight, non-brittle, highly efficient electronics opens the door to countless smart products.

- Nanoparticle copper suspensions have been developed as a safer, cheaper, and more reliable alternative to lead-based solder and other hazardous materials commonly used to fuse electronics in the assembly process.

- Other computing and electronic products include Flash memory chips for smart phones and thumb drives; ultra-responsive hearing aids; antimicrobial/antibacterial coatings on keyboards and cell phone casings; conductive inks for printed electronics for RFID/smart cards/smart packaging; and flexible displays for e-book readers.

# POLYMERS IN NANO SCIENCE

**A Ananya**
**II MSc Physics**

In the current scientific situation, nanotechnology is among the most rapidly emerging scientific fields. Nanotechnology is a general term that describes the study of the precise control of matter at the nanoscale, with a minimum size of 100 nanometers.

Polymers play an important role in nanotechnology because they combine various benefits like flexibility, processability, low cost, nanometer-sized, diverse functionalities, and microphase separation.

There are many applications for nanomaterials in the commercial, medical, military, and environmental fields due to their unique characteristics including electrical, catalytic, magnetic, mechanical, thermal, and imaging capabilities.

**There are two types of polymers:**

**Natural Polymer**

These raw materials occur naturally in biological environments. Examples include chitosan, albumin, heparin, silk, collagen, and silk peptides. The composition of these materials is usually biocompatible and entomologically biodegradable, which means the body will easily recognize, accept, and mechanically process the material.

**Synthetic Polymer**

Among poly (lactic acid), poly (glycolic acid), poly (lactide-co-glycolide), polyesters, polyurethanes, and poly (ethylene glycol), the greatest advantage lies in controllable chemical, structural, and mechanical properties. The biocompatibility of synthetic polymers is less predictable than that of natural polymers, and toxic biological reactions or inflammatory reactions may occur.

**Nano-scientific Study of Biopolymers**

A common biopolymer, gelatin, was widely applied in medicine for dressing wounds, as an adhesive, and so on. Porous gelatin scaffolds and films were produced with the help of solvents or gases as simple porogens, which enable the scaffolds to hold drugs or nutrients to be supplied to the wound for healing.

Electrospun PLGA-based scaffolds have been applied extensively in biomedical engineering, such as tissue engineering and drug-delivery systems.

MWCNT-incorporated electrospun nanofibers with high surface area-to-volume ratio and porous characteristics have also shown potential applications in many aspects of tissue engineering. Biomaterials made from proteins, polysaccharides, and synthetic biopolymers are preferred but lack the mechanical properties and stability in aqueous environments necessary for medical applications. Cross-linking enriches the properties of the biomaterials, but most cross-linkers either cause undesirable changes to the functionality of the biopolymers or result in cytotoxicity. Glutaraldehyde, the most widely used cross-linking agent, is difficult to handle, and contradictory views have been presented on the cytotoxicity of glutaraldehyde-cross-linked materials.

# NANOTECHNOLOGY IN ELECTRONICS

**N Rajakumari**
**II MSc Physics**

"Nature isn't classical, dammit and if you want to make a simulation of nature, you'd better make it quantum mechanical and golly it's a wonderful problem because it doesn't look so easy", remarked Richard Feynman.

"Graphene" and "Carbon nanotubes" are of the most promising nanomaterials for Electronics, offering superior properties such as high conductivity, flexibility and strength. However, they also pose significant challenges in terms of fabrication, integration and Environmental impact.

Graphene and carbon nanotubes have many applications in Electronics, such as transistors, sensors, batteries, solar cells and flexible displays. For instance, graphene transistors can operate at higher frequencies and lower voltages than silicon transistors, while carbon nanotubes can form nanouries that can conduct electricity with minimal resistance and heat generation.

**Advantages of Nanotechnology in Electronics**

Nanotechnology in Electronics can provide several benefits, such as improved performance, reduced energy consumption, enhanced functionality and lower costs.

**Disadvantages of Nanotechnology in Electronics**

Nanotechnology in Electronics also has some drawbacks, such as technical difficulties, safety risks and Ethical concerns.

# BASICS OF NANOSCIENCE AND ITS APPLICATIONS

**A Sherly Keats**
**II MSc Physics**

What is *nanoscience?* Nanoscience is the study of small-scale matter, the tiny building blocks of the material and the biological world. In general, it is the study of materials that have a size between 1 and 100 nanometres. Nanoscience is an interdisciplinary study of *Physics* and *Chemistry.* The ability to create new technologies or devices would not be possible without the use of *Nanomaterials.*

Energy is an important aspect in any new device, in order to make devices smaller approaching the nano-scale can reduce the energy cost, while increasing speed. Nanoscience incorporates application in *photonics, medical diagnostics, ultra-fast electronics* and many areas in which nanomaterials are used.

Advanced materials or nanomaterials include *superconductors, polymers, lasers and optoelectronics* and they can be found in applications ranging from computers and electronics to telecommunication and broadcasting to health care. Based on their dimensions nanomaterials are classified into four categories. They are

1. Zero dimension: These materials do not have any dimensions. Point materials including semiconductors, hollow spheres etc. Example: Fullerenes, Atomic clusters
2. One dimension: The one billionth of any given unit that is a film of thin type is known as one- dimension nanoparticles. They are used in the construction of nanoroads, nanotubes etc. Example: Fibres, Filaments, Whiskers
3. Two dimension: This structure consists of two dimensions that are outside the range of nanometric size. It has characteristics dependent upon the shapes. Monolayer, Multilayer, Self-assimilated etc. comes under this category.
4. Three dimension: In this, the structure consists of three dimensions. These are most widely used in magnetic materials, catalyst etc.

From the classification, it is evident that the behaviour of these particles is purely based on shapes, sizes, morphologies and dimensions.

*Applications of nanoscience:*

- In everyday materials: Nanomaterials are beginning to enable washable, durable "smart fabrics" equipped with flexible nanoscale sensors and electronics. Lightweighting of cars, trucks, boats could lead to significant fuel savings which is of great importance in today's world. Nano-engineered materials in automotive products include high-power rechargeable battery systems, thermoelectric materials for temperature control.
- In medical field: Nanotechnology enabled the invention of better imaging and diagnostic tools, paving way for earlier diagnosis, more specified treatment options. Nanomedicine researchers are looking at ways that nanotechnology can improve vaccines, including vaccine delivery without the use of needles.
- In energy aspect: Researchers are developing wires containing carbon nanotubes that will have much lower resistance than high tension wires, thus reducing power loss during transmission.

Like everything nanomaterials are have their own disadvantages, some of which are discussed below.

1. The exposure of nanomaterials due to inhalation. For example, materials like carbon nanofibers and nanotubes lead to *pulmonary fibrosis* examined from animal study.
2. Due to less knowledge and information about these materials, the process of manufacturing could be difficult and complex.
3. Nanoparticles are toxic to humans to some extent.
4. Nanomaterials are unstable.
5. Recycling of nanomaterials is hard.

**NANOPHYSICS IN SPORTS**

**RK Vignesh**
**II MSc Physics**

**Nanophysics in Tennis Ball:** Nanophysics plays a major role in Tennis Sport. There is Nanophysics behind the Tennis ball. Nanotechnology has been used in Tennis balls, providing a gas barrier that allows the balls to perform at an optimal level for a longer period of time. This Nanotech improve their longevity, making them better for the Tennis game. Double core Tennis balls have a nano composite coating that keeps it bouncing twice as long as an old-style ball. This *nano composite is a mix of butyl rubber, intermingled with nano clay particles*, giving the ball longer shelf life.

**Nanophyscis in Tennis Racquets:** Tennis Racquets have been modified to contain a nano material called *Carbon nano tubes.* These nano tubes are added to the frames to increase the strength, stability when hitting a Tennis ball. Nanotubes acts as a Catalyst. The physical properties of Carbon Nano Tubes (CNT), such as *larger specific surface areas, excellent electron conductivity, incorporated with good chemical inertness and relatively high oxidation stability*. Which is why Tennis Racquets are fast, more power and possess the stability to hit the ball.

**Nanophysics in Foot Ball:** Nanophysics creates an impact in Football game. In football, *nano clay linings* are found in footballs, where it acts as a barrier material upholding the pressure inside the ball allowing for prolonged use. Nano physics helps in foot-ball helmets. Nano technology embedded in foot-ball helmets gives real-time results. Combining nanotech with foam that can be placed inside a football helmet to measure the impact of each hit. When it is compressed, the *self-powered foam generates electrical signals* that are transmitted wirelessly to a tablet or computer in the hands of a coach or trainer.

# NANO-TECHNOLOGY

## "IN THE WORLD OF NANO, BIG THINGS COME IN SMALL PACKAGES"

## QUANTUM DOTS

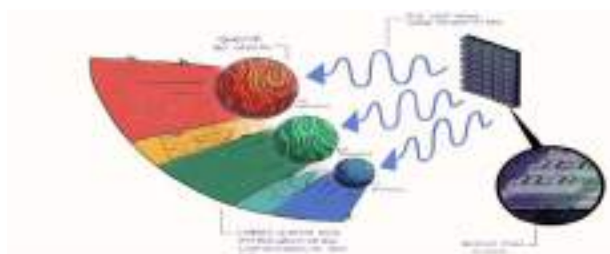
**P Barath Raj**

**I BSc Physics with Computer Applications**

Quantum dots are an emerging field of nanotechnology that has many potential applications in various domains, such as electronics, optics, medicine, and quantum computing. They are tiny crystals of semiconducting materials that have unique optical and electronic properties due to their extremely small size and quantum effects. They are sometimes called artificial atoms because they behave like individual atoms with discrete energy levels.

Quantum dots can emit or absorb light of different colours depending on their size and shape. They work by a principle called quantum confinement, which means that the electrons and holes in the quantum dot are restricted to a very small space, where they can only occupy certain energy levels, similar to the electrons in an atom. When the quantum dot is excited by an external source of energy, such as ultraviolet light, some of the electrons can jump to higher energy levels, leaving behind holes. When the electrons return to lower energy levels, they release the excess energy as photons of light. The colour of the light depends on the difference between the energy levels, which is determined by the size and shape of the quantum dot.

*Size and colour of the quantum dots*



*Application of quantum dots in displays*

Quantum dots can be made by different methods, such as colloidal synthesis, molecular beam epitaxy, or lithography. Colloidal synthesis is a common method that involves heating a solution of precursors that decompose and form nano-crystals. The nano-crystals can then be separated, purified, and coated with other materials to improve their stability and functionality.

Quantum dots have many potential applications in various fields, such as displays, lasers, solar cells, sensors, detectors, bio-imaging, and quantum computing.

In conclusion, quantum dots are an exciting and promising field of nanotechnology that has many applications and challenges. They can be used for various purposes, such as displays, lasers, solar cells, sensors, detectors, bio-imaging, and quantum computing. However, they also face some issues, such as toxicity, stability, scalability, and integration with other devices. Quantum dots are a fascinating topic to explore and learn more about, as they reveal the beauty and mystery of the physical world at the nanoscale.

# NANOTECHNOLOGY WITH CARBON NANOTUBES

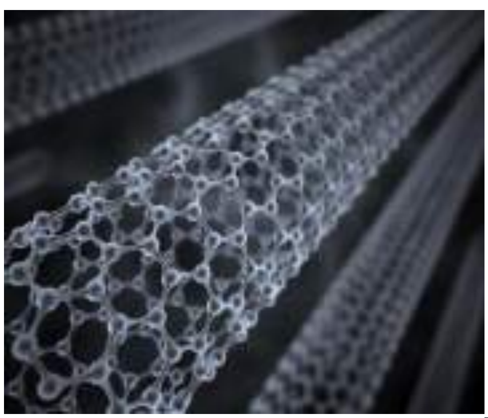
**CN Dev Arjun**

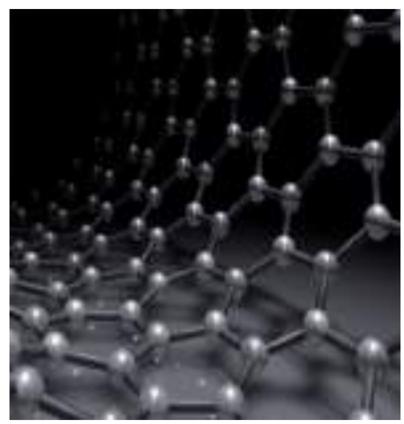
**I BSc Physics with Computer Applications**

The four core areas are: molecular-scale, ultralightweight, extremely strong, functional or smart materials; molecular-scale or nanoscale electronics with possibilities for quantum computing; molecular-scale sensors or actuators; and molecular machines or motors with synthetic materials. The underlying molecular-scale building blocks in all four areas are fullerenes and carbon nanotube-based molecular materials. Only the different aspects of their physical, chemical, mechanical, and electronic properties create the many applications possible with these materials in vastly different areas

## What are Carbon Nanotubes?

A carbon nanotube is a carbon allotrope that resembles a tube of carbon atoms. Carbon nanotubes are extremely robust and difficult to break, but they are still light. Because of their exceptional mechanical, electrical, and thermal properties, carbon nanotubes are one of the most investigated nanomaterials. Multiwall carbon nanotubes feature several concentric cylindrical lattices of carbon atoms, whereas single wall carbon nanotubes have only one cylinder of carbon atoms. Buckytube is another name for carbon nanotubes. Two-dimensional graphite is folded or rolled into a cylindrical shape structure to create nanotubes. Inside, nanotubes are hollow. The nanotube has a diameter of 1-3 nanometers.





## Carbon Nanotubes Uses

CNTs have a number of unique chemical, size, optical, electrical, and structural properties that make them appealing as drug delivery and biosensing platforms for the treatment of a variety of diseases and noninvasive monitoring of blood levels and other chemical properties of the human body, respectively. Carbon nanotubes (CNTs) have unique qualities, such as high surface-to-volume ratios, increased conductivity and strength, biocompatibility, ease of functionalization, optical properties, and so on.

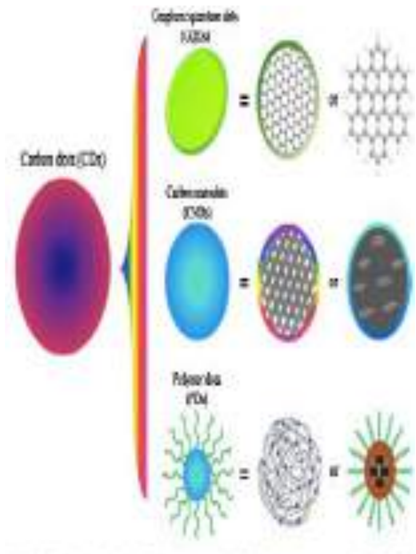
Carbon nanotubes are utilized in energy storage, device modelling, automotive parts, boat hulls, sporting goods, water filters, thin-film electronics, coatings, actuators, and electromagnetic shields. Because of their large surface area, CNTs have been successfully used in pharmacy and medicine to adsorb or conjugate a wide range of medicinal and diagnostic substances.

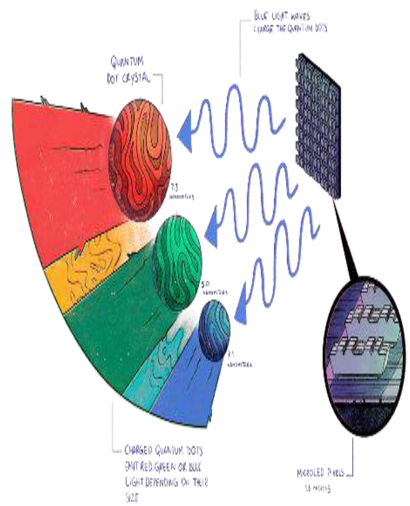
**QUANTUM DOTS**

**M Mathesh**

**I BSc Physics with Computer Applications**

Quantum dots are nanoscale semiconductor particles, typically ranging from 2 to 10 nanometers in size. These minuscule structures exhibit remarkable properties due to their size and composition. When semiconductor materials like cadmium selenide (CdSe) or indium arsenide (InAs) are confined to such small dimensions, leading to quantized energy levels.




Imagine electrons within these quantum dots as confined within a tiny box. Just as a violin string can vibrate at specific frequencies, the electrons can only occupy certain energy levels. This energy quantization results in discrete electronic transitions, manifesting as vibrant colors.

These properties make quantum dots incredibly versatile. In displays, they enhance color accuracy and brightness, while in solar cells, they boost light absorption, potentially revolutionizing energy conversion efficiency. Biomedical applications utilize their unique emission spectra for cellular imaging at unprecedented resolutions. Moreover, quantum dots are even considered for quantum computing due to their potential to serve as quantum bits or qubits. While quantum dots hold immense promise, challenges like toxicity due to heavy metal content persist. Over the past decade, these nanoscale wonders have spurred a scientific revolution, fostering innovations that span electronics, photonics, medicine, and beyond.

# NANO TECHNOLOGY

**GJ Monica**

**I BSc Physics with Computer Applications**

## Introduction to Nanomaterials

Nanomaterials are cornerstones of nanoscience and nanotechnology. Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed. It is already having a significant commercial impact, which will assuredly increase in the future.

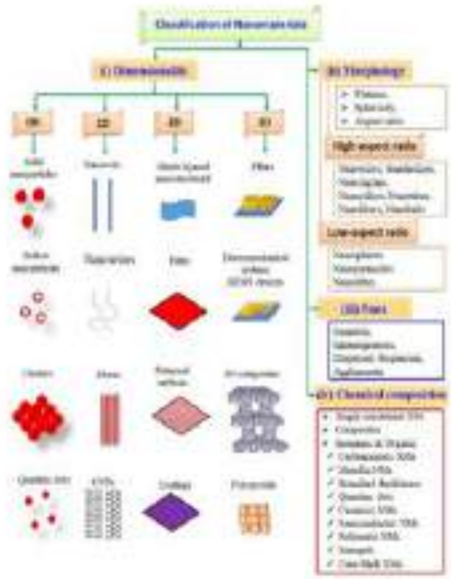
## What are Nanomaterials?

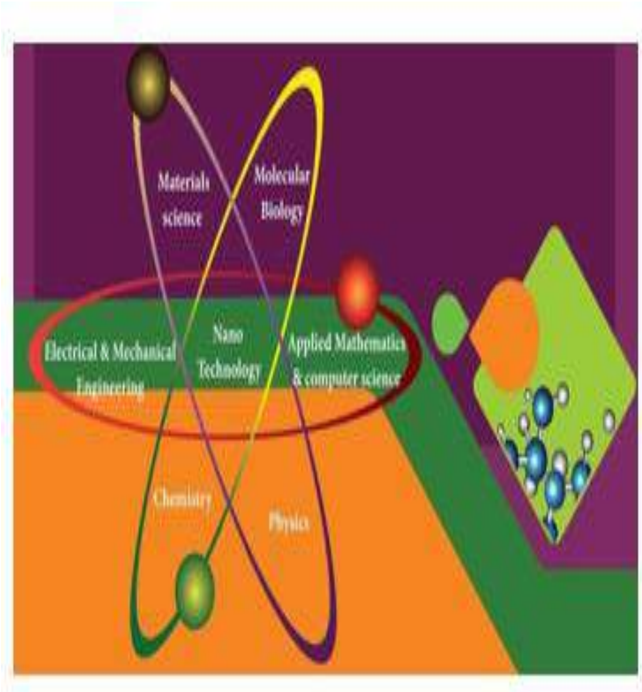
Nanoscale materials are defined as a set of substances where at least one dimension is less than approximately 100 nanometers. Nanometer is one millionth of a millimeter − approximately 100,000 times smaller than the diameter of a human hair. Nanomaterials are of interest because at this scale unique optical, magnetic, electrical, and other properties emerge. These emergent properties have the potential for great impacts in electronics, medicine, and other fields.

## Types of Nanomaterials

Nanomaterials can be categorized into four types such as: (1) inorganic-based nanomaterials; (2) carbon-based nanomaterials; (3) organic-based nanomaterials; and (4) composite-based nanomaterials. Generally, inorganic-based nanomaterials include different metal and metal oxide nanomaterials. Examples of metal-based inorganic nanomaterials are silver (Ag), gold (Au), aluminum (Al), cadmium (Cd), copper (Cu), iron (Fe), zinc (Zn), and lead (Pb) nanomaterials, whereas examples of metal oxide- based inorganic nanomaterials are zinc oxide (ZnO), copper oxide (CuO), magnesium aluminum oxide ($MgAl_2O_4$), titanium dioxide ($TiO_2$), cerium oxide ($CeO_2$), iron oxide ($Fe_2O_3$), silica ($SiO_2$), and iron oxide ($Fe_3O_4$), etc.

Carbon-based nanomaterials include graphene, fullerene, single-walled carbon nanotube, multiwalled carbon nanotube, carbon fiber, an activated carbon, and carbon black. The organic-based nanomaterials are formed from organic materials excluding carbon materials, for instance, dendrimers, cyclodextrin, liposome, and micelle. The composite nanomaterials are any combination of metal-based, metal oxide-based, carbon-based, and/or organic-based nanomaterials, and these nanomaterials have complicated structures like a metal-organic framework.





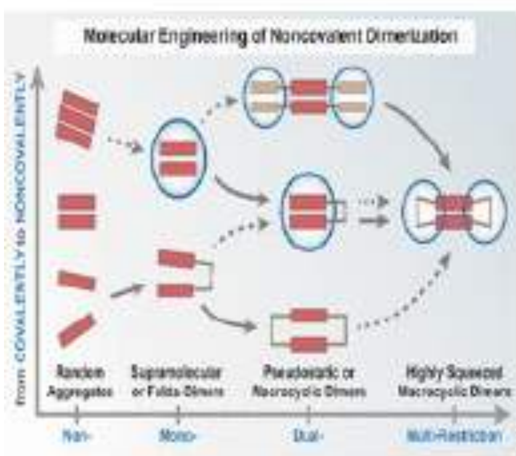
**MOLECULAR ENGINEERING: PIONEERING RESEARCH FOR THE FUTURE.**

**T Navinaa**

**I BSc Physics with Computer Applications**

**Introduction**

In the realm of scientific research, molecular engineering stands as an intriguing and dynamic field that combines the principles of chemistry, physics, and materials science. With its focus on designing and manipulating molecules at the atomic and molecular level, molecular engineering has captured the attention of scientists worldwide. This detailed explanation will delve into the captivating world of molecular engineering, exploring its exciting research areas and their potential impact on diverse fields such as healthcare, electronics, sustainability, and beyond.





**Nanoscale Engineering and Nanotechnology**

At the forefront of molecular engineering research lies the exposition of nanoscale phenomena and the development of nanotechnology. Scientists manipulate and engineer induvial atoms and molecules to fabricate nanoscale structures with precise control over their properties.

The research encompasses areas such as nanoelectronics, nanosensors, and nanomedicine. By harnessing the unique properties of nanoparticles and nanomaterials, researchers can revolutionize fields like electronics, sensing, and targeted drug delivery. This opens opportunities for ultra-efficient electronics, highly sensitive biosensors, and nanomedicines with enhanced therapeutic efficacy.

**Computational Modeling and Machine Learning**

Computational tools enable scientists to stimulate and analyse molecular interactions, predict properties, and screen vast libraries of compounds for desired functionalities.

**Conclusion**

Molecular engineering represents a captivating and rapidly advancing field of research. Molecular engineering combines nanophysics and chemistry to design materials at the atom and molecular level. It enables the creation of nanoscale materials with enhanced properties for applications in electronics, energy systems, and healthcare.

## NANOTECHNOLOGY IN ELECTRONICS

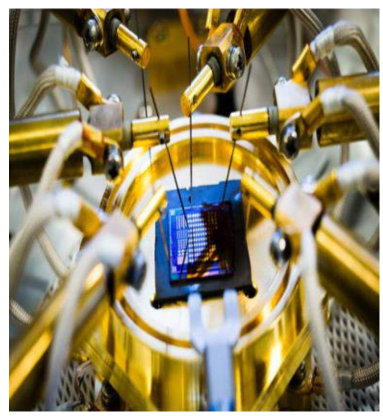
**G Sanjay**

**I BSc Physics with Computer Applications**

Nanotechnology in electronics allows for faster, smaller, and more powerful handheld devices. It also allows for new display technologies. These products are more conductive nanomaterials, data storage, quantum computing. It also provides printable and flexible electronics and magnetic nanoparticles for data storage.

### Nanoelectronics

Use of nanotechnology in electronic components makes nanoelectronics. These parts are only a few nanometers in size. But, as electrical components become smaller, they become more difficult to fabricate. Nanotechnology In Electronic Devices encompasses a wide range of devices and materials. Also, these materials are so small that physical effects alter the properties of the materials on a nanoscale. Inter-atomic interactions and quantum mechanical properties are important in the operation of these devices.



### Applications of Nanoelectronics

Nanoelectronics uses nanotechnology in electronic components. There are various applications such as computing and electronic devices; for example, devices such as flash memory chips, and the antimicrobial and antibacterial coatings for mouse, keyboard. Also, mobile phone castings are good examples of nanoelectronics. The goal of nanoelectronics is to process, send, and keep information. It does so by utilizing matter features that are distinct from macroscopic properties.

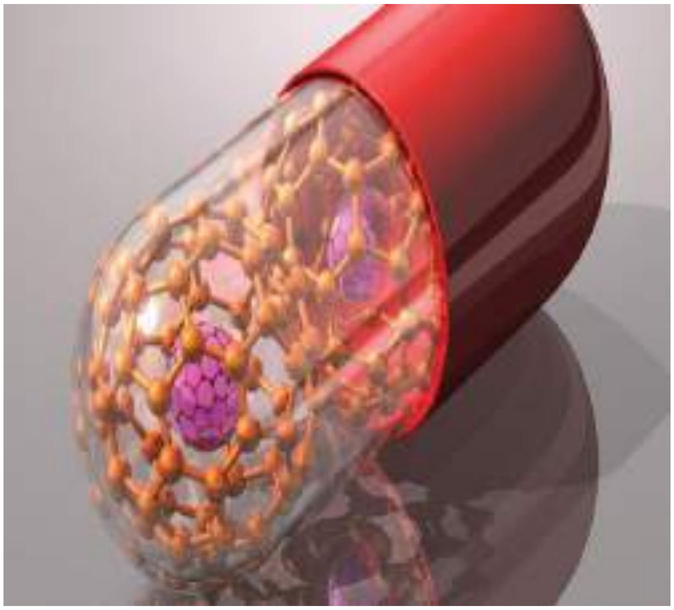
### Conclusion

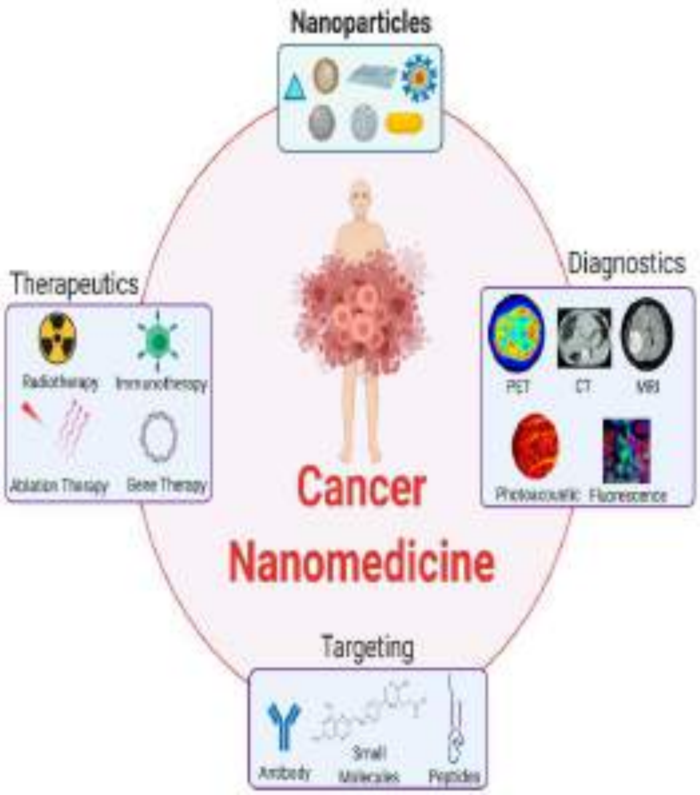
Nanotechnology In Electronic Devices has the potential to change a wide range of electronic goods. It can also bring a change in the techniques and applications. This includes nano transistors, nano diodes, OLED, plasma displays, and quantum computers.

**NANO MEDICINE**

**G Vanitha Shri**

**I BSc Physics with Computer Applications**





Nano medicine is the medical application of Nanotechnology. Nano medicine ranges from the medical applications of Nano materials and biological devices, to Nano electronic biosensors, and even possible future applications of molecular Nano technology such as biological machines.

**Uses**

Nano med is used for upcoming medical field that uses Nano technological expertise to prevent and treat severe conditions, including cancer, cardiovascular disease and other illness.

**Types of Nano Medicine**

According to the type and structure of the carriers, Nano medicines are primarily classified into liposome, antibody-drug conjugate, inorganic Nano particle, polymer Nano particle, dendrimer, micelle, polymer-drug conjugate, virus-derived vector, Nano crystal, cell-derived carrier and protein-bound Nano particle.

**Main Applications in Nano Medicines**

- Drug delivery
- Applications
- Imaging
- Sensing
- Sepsis Treatment
- Tissue Engineering
- Medical Devices

**Benefits of Nano Medicine**

Nano medicine improves drug target specificity as nano particles are engineered to bind the specific targets on cancer cells. A common characteristic of solid tumors is leaky blood vessels. Nano medicines, due to their size, preferentially accumulate in tissue through the leakage in the blood vessels.

**Examples of Nano Medicine**

Some specific ways that Nano medicine is being used or studied are for COVID-19 VACCINES:

- Pfizer
- Moderna

# RADIOSENITIZING HIGH-Z METAL NANOPARTICLES FOR ENHANCED RADIOTHERAPY OF GLIOBLASTOMA MULTIFORME

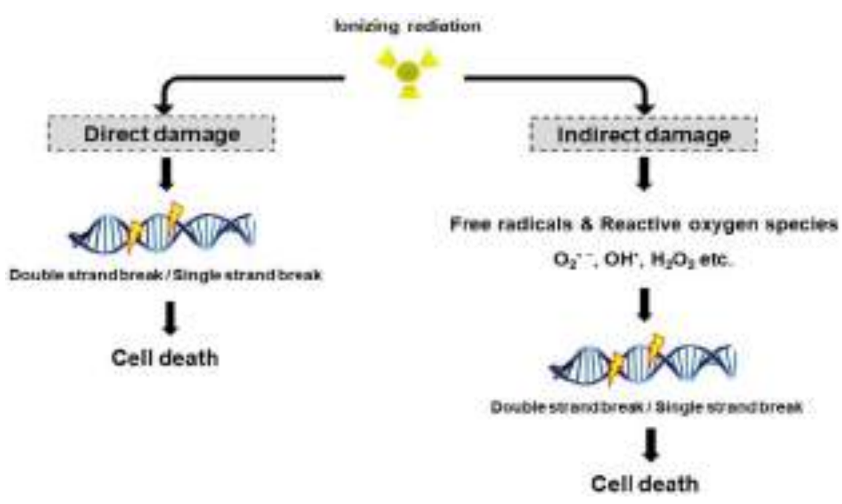
**B Viswathi**

**I BSc Physics with Computer Applications**

Radiotherapy is an essential step during the treatment of glioblastoma multiforme (GBM), one of the most lethal malignancies. The survival in patients with GBM was improved by the current standard of care for GBM established in 2005 but has stagnated since then. Since GBM is a radioresistant malignancy and the most of GBM recurrences occur in the radiotherapy field, increasing the effectiveness of radiotherapy using high-Z metal nanoparticles (NPs) has recently attracted attention. This review summarizes the progress in radiotherapy approaches for the current treatment of GBM, the physical and biological mechanisms of radiosensistization through high-Z metal NPs, and the result of studies on radiosensitization in the in vitro and in vivo GBM models using high-Z metal NPs to date.

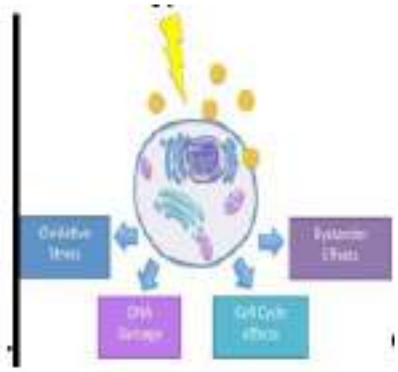
## Introduction

Glioblastoma multiform (GBM) is one of the most lethal malignancies with a 5-year survival rate of 5.5% and a median survival of 15 months. Glioblastoma multiform is categorized as a grade IV astrocytic lineage glioma, and the most common brain malignancy, accounting for 47.1% of all malignant primary brain tumors, 82% of malignant gliomas, 56.1% of all gliomas, and 14.9% of all primary brain tumors.The incidence rate of GBM is higher in older people than in younger people and it is the highest in the age of 75−84 years. In addition, the incidence rate of GBM is 1.58 times higher in males than females.Therefore, multiple radiosensitizing strategis are actively under development, including PI3K pathway inhibitors, DNA repair inhibitors, hyperthermia, aldehyde dehydrogenase inhibitors, and high atomic number (high-Z) metal nanoparticles (NPs).



**Radiotherapy for GBM Treatment**

Radiotherapy is one of the most effective and widely used cancer therapeutic modalities. About 50% of cancer patients are treated with radiotherapy either for curative adjuvant, or palliative purposes.



The need for postoperative radiotherapy was strongly recommended due to the invasive nature of GBM, which makes complete resection with acceptable neurological results almost impossible. In the 1970s, several randomized clinical trials to demonstrate the benefit of radiotherapy were first performed by the Brain Tumor Study Group (BTSG). In the first clinical trial (BTSG 66-01), whole-brain radiotherapy (WBRT) resulted in prolonged survival (median survival: 8.4 vs. 3.5 months, $P < 0.05$). The second clinical trial (BTSG 69-01) also showed that the addition of WBRT resulted in improved survival compared to that in patients receiving only the best supportive care or chemotherapy ($P = 0.001$).

**Conclusion and Future Perspectives**

This review described the mechanisms of radiosensitization by high-Z metal NPs and summarized the literature describing high-Z metal NPs mediated radiosensitization in GBM. The mechanism of radiosensitization by high-Z metal NPs is not confined to the physical aspect alone but extended to chemical/biological effects. Multiple in vitro and pre-clinical in vivo studies proved the radiosensitizing effect of high-Z metal NPs in different GBM models. Although various types of high-Z metal NPs were found to be useful for radiosensitization, there have not been enough studies to systematically compare the efficacy of different types of NPs, except for one study that reported the superiority of the silver NPs over gold NPs. Targeting efficiency of high-Z metal NPs could determine the radiosensitizing efficiency because specific accumulation of the NPs in the tumor cells enhance the specific radiosensitization of cancer tissue compare to surrounding normal tissue. The strategies for crossing the BBB and active targeting would enhance the targeting ability of the NPs. Furthermore, intracellular location of the NPs affects the radiosensitizing effect. Thus, it is recommended to develop (1) intracellular targeting strategies of NPs, desirably to nucleus or mitochondria, along with (2) micro dosimetry methods to monitor the different radiosensitizing effect in micro level. Also, further studies are warranted to elucidate factors that can be used to maximize the radiosensitizing effect by comparing different types of the metal elements, functionality, size, and shape.

# NANO PHYSICS

**R Yashwanth**
**I BSc Physics with Computer Applications**

The nanophysics is halfway between the sin scales of quantum mechanics and may physics governed by the laws of Newton and Einstein. The correct definition of nanophysics is the physics of structures with dimensions as the nanometer range or of phenomena occurring in nanoseconds. Modern physical methods whose fundamental are developed in physics laboratories have become important in nanoscience. Nanophysics brings together multiple disciplines, using theoretical and experimental methods to determine physical properties of materials. Inthe nano size range the listing properties include the structural, electronic optical, and thermal behavior of nanomaterial, electrical and thermal conductivity, and the forces between scale objects. Nanophysics has now become an independent branch of physics, simultaneously expanding into many new areas and playing a vital role in fields that were the domain of engineering, chemical, or life sciences.

Nanoscience and nanotechnology are all about relating and exploiting phenomena for materials having one, two or three dimensions reduced to the nanoscale. Breakthroughs in nanotechnology require a firm grounding in the principles of nanophysics. It is intended to fulfill a crucial purpose Nanophysics aim to connect scientists with disparate interests to begin interdisciplinary projects and incorporate the theory and methodology of other fields into their work. The evolution may be related to three exciting happenings that took place in a short span from the early to mid-1980s with the award of Nobel prizes to each of them. These were:

1. the discovery quantum Hall effect in a two-dimensional electron gas;
2. the invention of scamming tanelling microscopy (STM), and
3. the discovery of fullerene as the new form of carbon.

# Riddles, Quiz & Poem

# RIDDLES

**M Sai Kumar**
**II MSc Physics**

**Riddle 1:** I am a tiny particle, unseen by the naked eye, working wonders in labs, making scientists sigh. Manipulating matter at a minuscule scale, in nanoworld, my actions never fail. What am I?

Answer**: Nanoparticle**

**Riddle 2:** With a structure so small, I'm a scientist's delight, Invisible to most, yet I shine so bright. My properties change at the nanoscale, used in displays and solar cells, without fail. What am I?

Answer: **Quantum dots**

**Riddle 3**: I'm made of carbon, but incredibly small, in electronics and medicine, I play a crucial role. A single layer of atoms, arranged just right, Innovation and discovery, I bring to light. What am I?

Answer: **Graphene**

**Riddle 4**: I'm a tube of carbon, slender and long, in strength and conductivity, I am strong. Used in electronics and materials quite vast, my name is synonymous with the future's cast. What am I?

Answer: **Carbon nanotube**

**Riddle 5**: I am a powerful microscope, with a special skill, peering into the nanoscale, revealing what's hidden still. I use a sharp tip to scan and probe, uncovering details, a nano scientist’s strobe. What am I?

Answer: **Scanning probe microscope (SPM**)

**Riddle 6:** I am a property of particles so small, their behaviour is strange, defying it all. With wave-like and particle-like traits, they exist, understanding me requires a physicist's twist. What am I?

Answer: **Wave-particle duality**

**Riddle 7:** I am a force that governs the nanoscale, Pushing and pulling, a mysterious tale. Between charged particles, my influence is strong, Nanophysics studies me, unravelling right and wrong. What am I?

Answer: **Electromagnetic force**

**Riddle 8:** I'm a unit so tiny, it measures the small, in nanophysics, I stand tall. Equal to one billionth of a meter, it's true, the nanoworld's ruler, I help scientists pursue. What am I?

Answer**: Nanometer**

**Riddle 9:** I'm a phenomenon, a puzzle to solve, in nanophysics, I continuously evolve. Particles align, pointing in one direction, Magnetic properties, a nanoscale reflection. What am I?

Answer: **Ferromagnetism**

**Riddle 10:** I'm a principle, a key to understand, in nanophysics, where things get grand. Hot moves to cold, order out of chaos, Entropy decreases, an essential toss. What am I?

Answer**: Second law of thermodynamics**

**Riddle 11:** I'm a fundamental particle, known for my charge, in nanoelectronics, I take the lead and enlarge. Flowing through wires, I bring power and might, without me, devices would be devoid of light. What am I?

Answer: **Electron**

**Riddle 12:** I'm a force that binds atoms tight, i nanomaterials, I give them their might. With attractions and repulsions, I hold things together, without me, nanoscience would be lost forever. What am I?

Answer: **Van der Waals force**

**Riddle 13:** I'm a crystal lattice, organized and neat, At the nanoscale, my structure is hard to beat. With unique properties, I create a stir, used in sensors, filters, and things that blur. What am I?

Answer: **Nanocrystal**

**Riddle 14**: I'm a process of breaking things down, Into smaller pieces, particles renowned. Using high energy, I transform with might, Nanoparticles emerge, sparkling and bright. What am I?

Answer: **Nano synthesis**

**Riddle 15:** I'm a field of science, exploring the small, manipulating atoms, one by one, standing tall. Innovation and discovery, my ultimate goal, Nanotechnology is the name for this role. What am I?

Answer**: Nanotechnology**

# QUIZ

**V Yazhini**

**II MSc Physics**

1. Question 1: What is nanotechnology?
   A. The study of extremely small particles
   B. The application of science and engineering at the nanoscale
   C. The study of microscopic organisms
   D. The study of materials at the atomic level
   Answer: B) The application of science and engineering at the nanoscale

2. Question 2: What is the size range of nanomaterials?
   A. 1 to 100 millimeters
   B. 1 to 100 micrometers
   C. 1 to 100 nanometers
   D. 1 to 100 picometers
   Answer: C) 1 to 100 nanometers

3. Question 3: Which material is commonly used in nanoelectronics due to its excellent electrical conductivity?
   A. Carbon nanotubes
   B. Gold nanoparticles
   C. Silicon nanowires
   D. Zinc oxide nanoparticles
   Answer: A) Carbon nanotubes

4. Question 4: What is the phenomenon called when nanomaterials exhibit different properties compared to their bulk counterparts?
   A. Quantum confinement
   B. Surface plasmon resonance
   C. Electron tunneling
   D. Schottky effect
   Answer: A) Quantum confinement\

5. Question 5: What field of medicine utilizes nanotechnology for targeted drug delivery?
   A. Nanomedicine
   B. Nanosurgery
   C. Nanoimaging
   D. Nanotoxicology
   Answer: A) Nanomedicine

6. Question 6: Which technique is commonly used to visualize nanoscale structures?
    A. Atomic force microscopy (AFM)
    B. Polymerase chain reaction (PCR)
    C. Magnetic resonance imaging (MRI)
    D. Gas chromatography-mass spectrometry (GC-MS)
    Answer: A) Atomic force microscopy (AFM)

7. Question 7: Which property of nanomaterials is responsible for their enhanced reactivity and catalytic activity?
    A. High surface area-to-volume ratio
    B. Increased density
    C. Larger particle size
    D. Decreased stability
    Answer: A) High surface area-to-volume ratio

8. Question 8: What is the primary concern regarding the safety of nanomaterials?
    A. Their potential to cause allergies
    B. Their toxicity to aquatic organisms
    C. Their ability to degrade in the environment
    D. Their potential to penetrate biological barriers
    Answer: D) Their potential to penetrate biological barriers

9. Question 9: Which industry has benefitted from nanotechnology through the development of stronger and lighter materials?
    A. Automotive
    B. Agriculture
    C. Textiles
    D. Construction
    Answer: A) Automotive

10. Question 10: What is the term used to describe the process of self-assembly of nanoscale building blocks into ordered structures?
    A. Nanofabrication
    B. Nanoengineering
    C. Nanolithography
    D. Nanoscale self-assembly
    Answer: D) Nanoscale self-assembly

11. Question 11: Which of the following is a potential application of nanosensors?
    A. Detecting air pollution
    B. Creating artificial intelligence
    C. Developing renewable energy sources
    D. Designing self-cleaning materials
    Answer: A) Detecting air pollution

12. Question 12: What is the primary factor that determines the properties of nanoparticles?
    A. Shape
    B. Size
    C. Composition
    D. Surface area
    Answer: B) Size

13. Question 13: What technique is commonly used to visualize nanoparticles?
    A. Scanning electron microscopy (SEM)
    B. Transmission electron microscopy (TEM)
    C. Atomic force microscopy (AFM)
    D. X-ray diffraction (XRD)
    Answer: A) Scanning electron microscopy (SEM)

14. Question 14: What is the primary application of quantum dots?
    A. Energy storage
    B. Drug delivery
    C. Solar cells
    D. Imaging and display technologies
    Answer: D) Imaging and display technologies

15. Question 15: What is the term used to describe the tendency of nanoparticles to clump together?
    A. Agglomeration
    B. Dispersion
    C. Dissolution
    D. Separation
    Answer: A) Agglomeration

## POEM

### EXPLORING THE NANOSCOPIC WORLD

**T Navinaa**

In a world of tiny things so small,
Where wonders unfold and mysteries call.
Nanophysics, a captivating dance,
Where particles twirl and atoms enhance.

Microscopes reveal a hidden sphere,
Exotic realms where science peers.
In labs, scientists pave the way,
Crafting materials for a brighter day.

Carbon tubes, like tendrils divine,
Strong and flexible, they intertwine.
Medicine finds hope in Nano's Might
Targeting diseases with pinpoint sight.

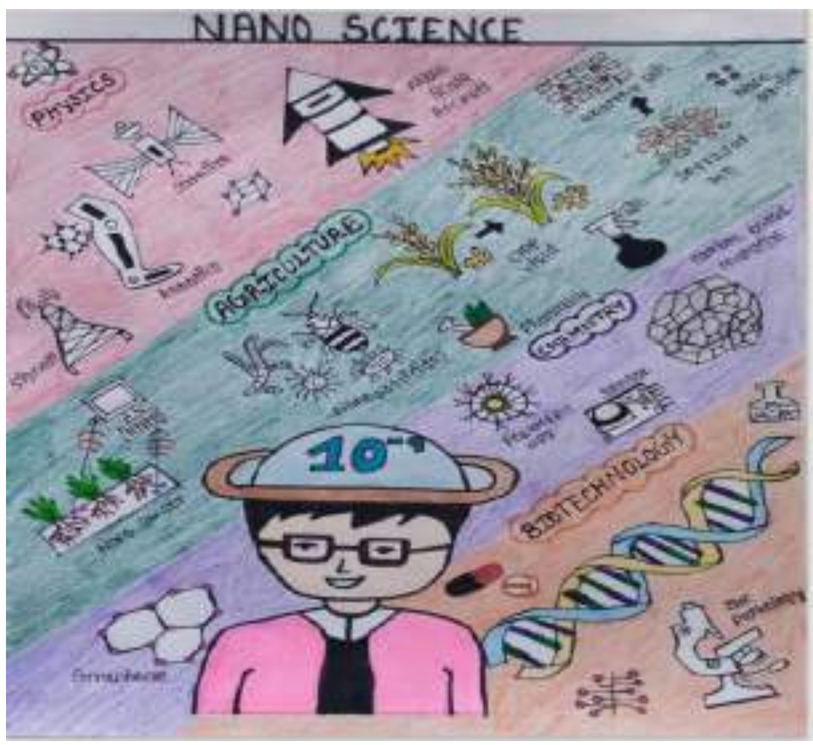
Energy bows to Nano's grace,
Efficiency and power in this space.
Solar cells and batteries, a leap in stride,
Unleashing sustainable energy worldwide.

Yet, beyond science's quest for truth,
Nano invites contemplation and uncovers youth.
The realm of small, where wonders are found,
A symphony of knowledge, forever unbound.

# CREATIVITY CORNER


**G Aswinth**

**I BSc PCA**




**NT Ruba Devi**

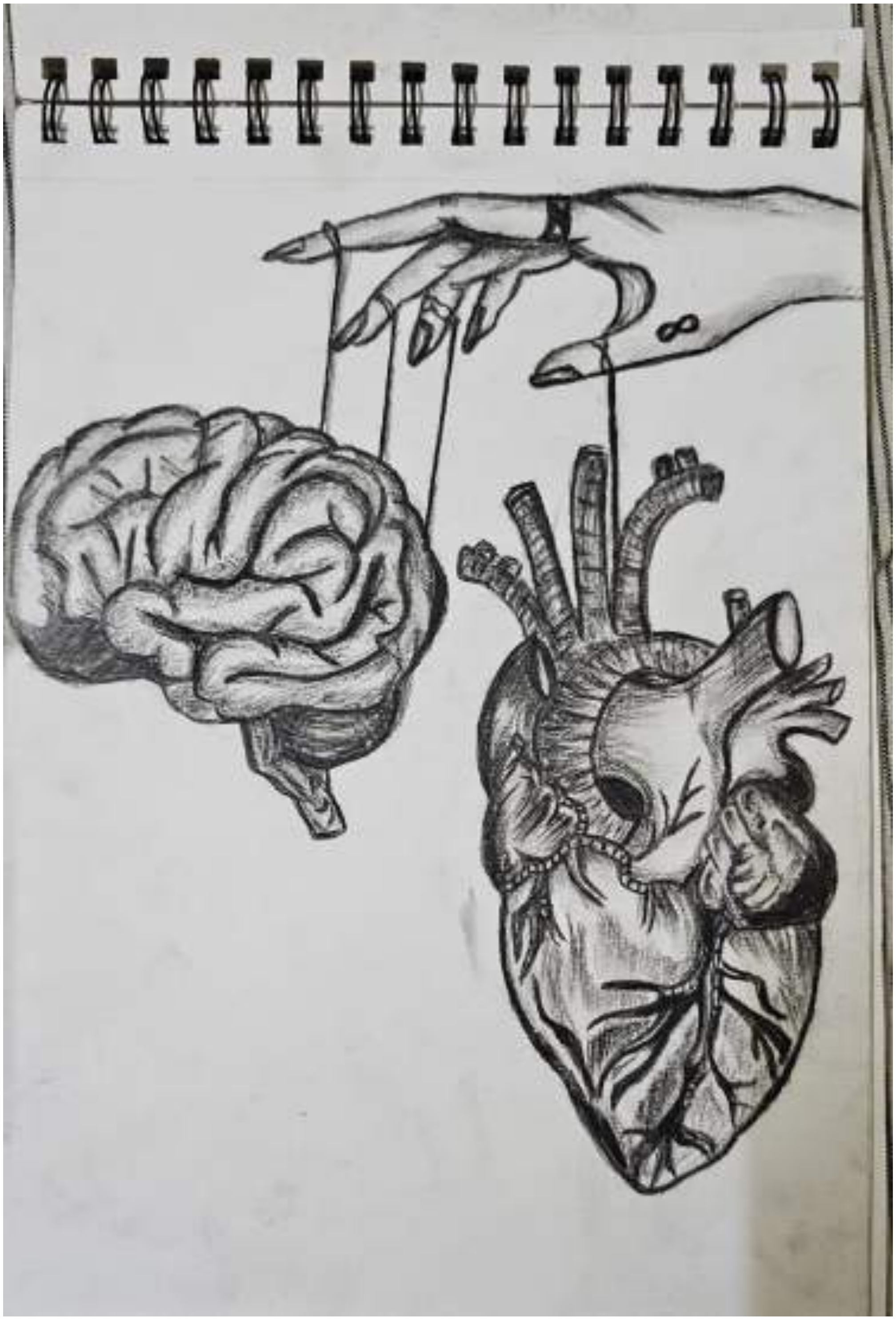
**II MSc Physics**


**M Abhyankar**

**II BSc PCA**

**M Abhyankar**

**II BSc PCA**



**M Abhyankar**

**II BSc PCA**


**M Abhyankar**

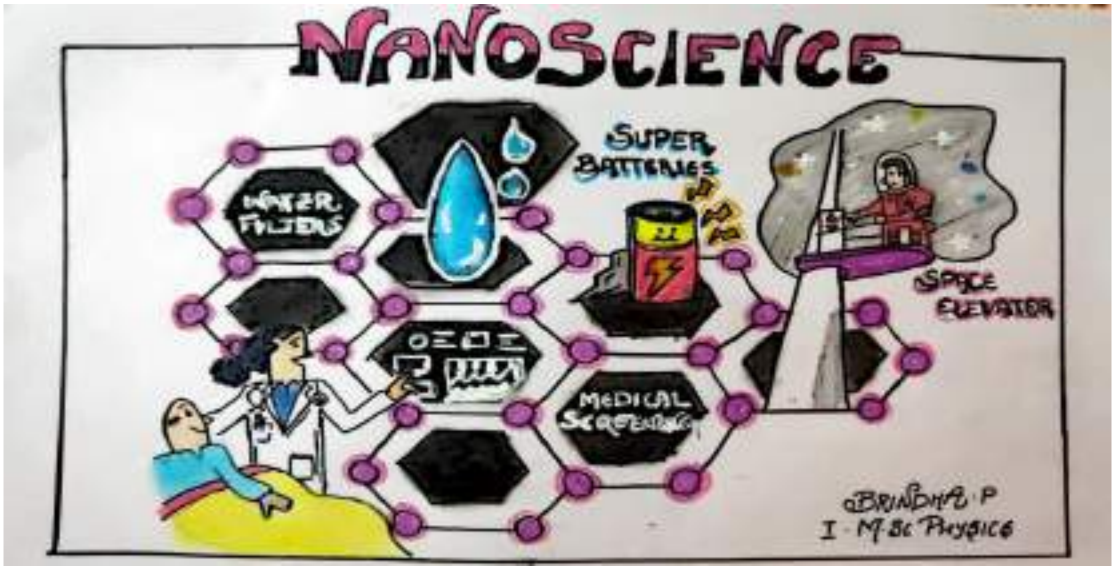
**II BSc PCA**

**M Abhyankar**

**II BSc PCA**

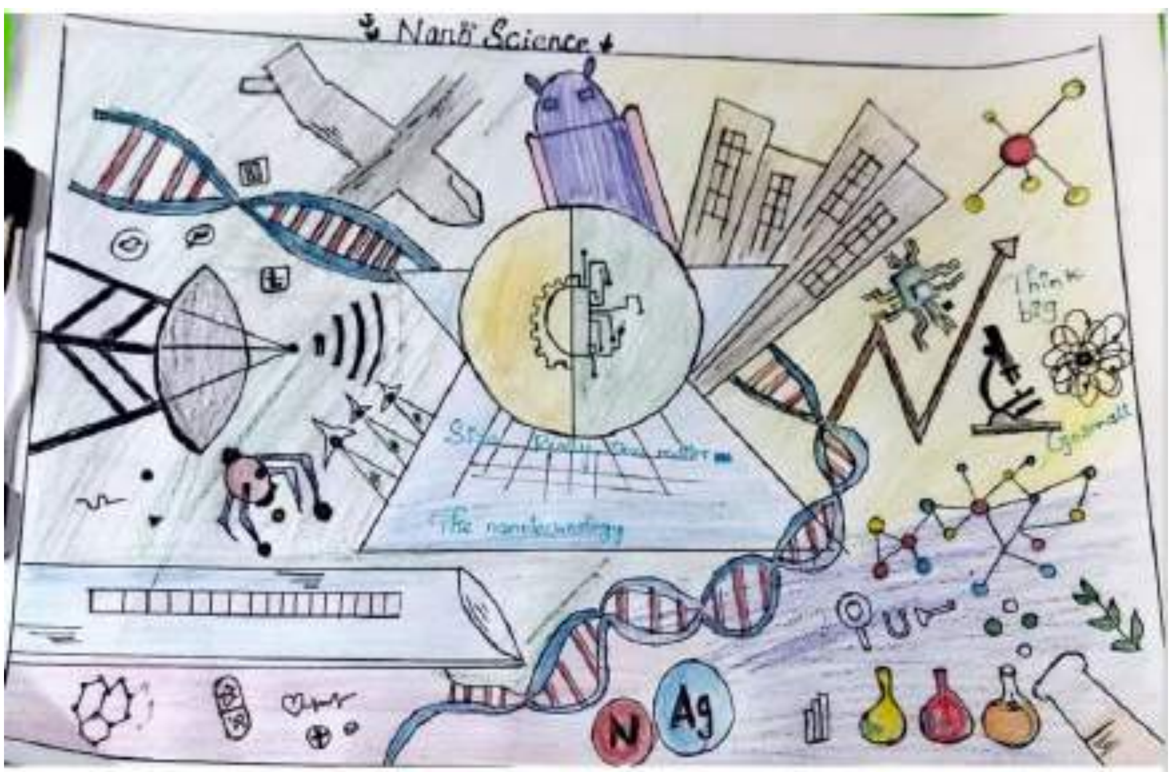
**M Abhyankar**

**II BSc PCA**



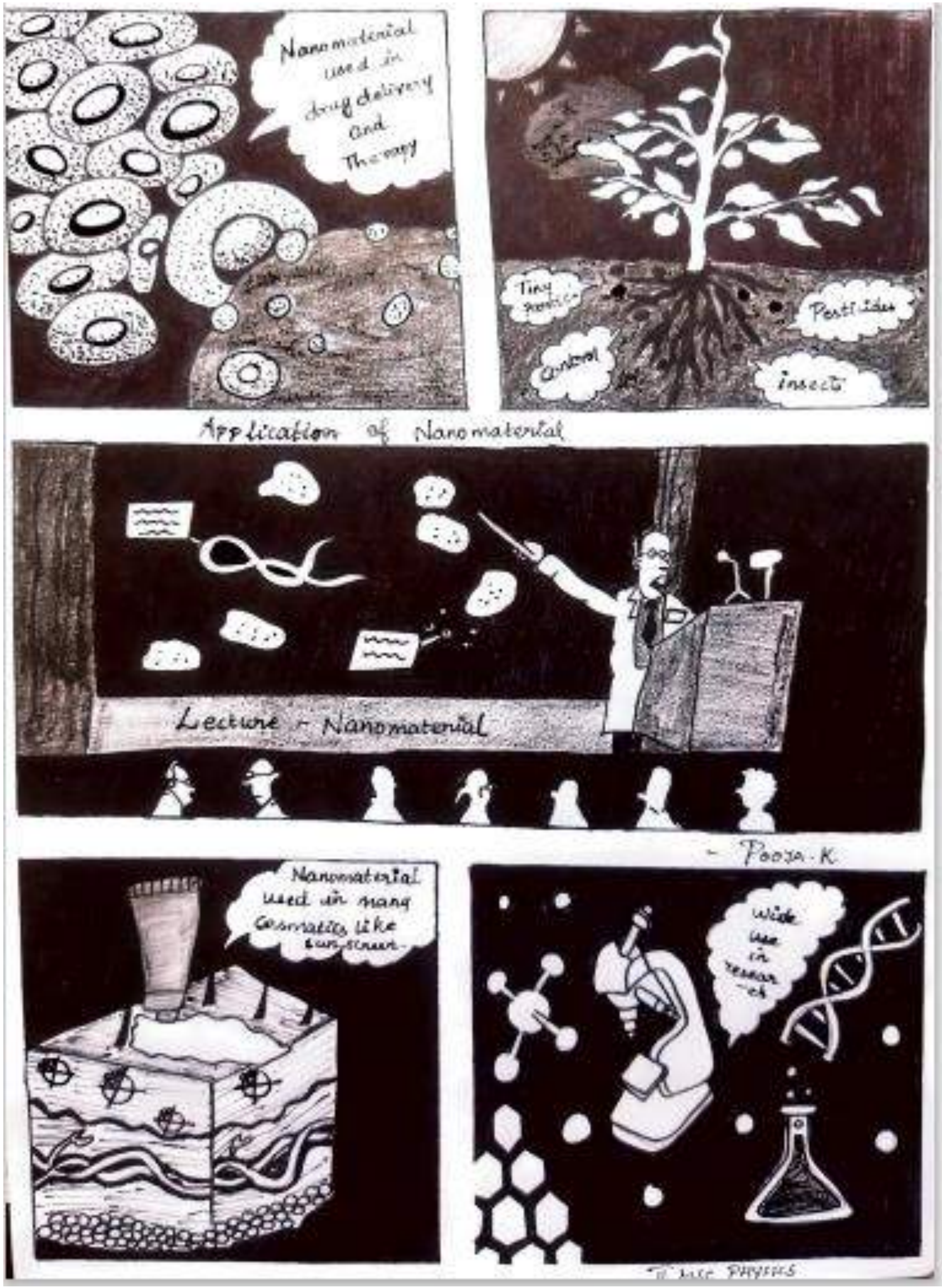

**P Brindha**

**II MSc Physics**




**N Malathy**

**II MSc Physics**




**K Pooja**

**II MSc Physics**

# ACHIEVEMENTS OF STUDENTS

| Name of the Student | Class | Name of the Event | College/Program | Prize |
|---|---|---|---|---|
| C Nanda Kumaran | II BSc PCA | Potpourri | Ethiraj College for Women/Ripples | I |
| D Aswath | II BSc PCA | Potpourri | Ethiraj College for Women/Ripples | |
| P Dheenadhayalan | II BSc PCA | Sci-Fi Writing | Ethiraj College for Women/Ripples | III |
| S Vignesh | II BSc PCA | Uriadi | DDGDVC/Farm Fest | I |
| C Nanda Kumaran | II BSc PCA | Uriadi | DDGDVC/Farm Fest | II |
| S Reshmi | II BSc PCA | Folk Dance | DDGDVC/Farm Fest | II |
| N Srija | II BSc PCA | Folk Dance | DDGDVC/Farm Fest | |
| R Subhashini | II BSc PCA | Folk Dance | DDGDVC/Farm Fest | |
| P Bhavya | II BSc PCA | Folk Dance | DDGDVC/Farm Fest | |
| M Amirtha | II BSc PCA | Folk Dance | DDGDVC/Farm Fest | |
| V Dhivya Dharshini | II BSc PCA | Essay Writing | DGDGVC/World Students' Day | I |


C Nanda Kumaran, D Aswath, J Vishal – II Prize – Potpourri – Ripples


P Dheenadhayalan – III Prize – Sci-Fi Writing – Ripples


S Vignesh – I Prize – Uriadi – Farm Fest


C Nanda Kumaran – I Prize – Uriadi – Farm Fest


P Bhavya, N Srija, R Subhashini, S Reshmi, M Amirtha – II Prize – Folk Dance – Farm Fest

## SCIENCE EXHIBITION – MODEL MAKING

| Team | Name of the Student | Class | Model Name | Prize |
|---|---|---|---|---|
| 1 | Hariharan B | II BSc PCA | Mini bike | I |
| | Dhivya Dharshini V | | | |
| | Vignesh S | | | |
| 2 | Lingeshwar P | II BSc PCA | Mini-hydrogen generator | II |
| | Edison J | | | |
| | Dinesh Kumar K | | | |
| 3 | Aswath D | II BSc PCA | Laser light security alarm | III |
| | Deenadhayalan P | | | |
| | Matheshwaran S | | | |
| 4 | Vishal J | II BSc PCA | Power supply using DC motor | III |
| | Vikash N | | | |
| | Kishore Kumar M | | | |
| | Tirish Kumar A | | | |
| 5 | Karthikeyan S | II BSc PCA | Earthquake alarm | III |
| | Navanesh B | | | |
| | Nandha Kumaran C | | | |
| 6 | Sai Manikandan S | II BSc PCA | Solar panel using silicon coated compact disc | III |
| | Pavan Kumar J | | | |
| | Abhyankar M | | | |


Post Graduate Department of Physics


Post Graduate Department of Physics


Post Graduate Department of Physics


Post G te Department of Physics


Department of Physics


oss Goverdhan Doss Vaishnav College (Shift-II)
(Autonomous)
t Graduate Department of Physics

**R. Kanishka Sharma** of II MSc Physics received *Library Best User Award*

**<u>SPORTS</u>**

PK Akash, II PCA – Kho-Kho, Third Place, University of Madras – B Zone

## NCC

**A. Thirish Kumar** of II BSc Physics with Computer Applications from DDGD VAISHNAV COLLEGE 1 TN (BN) NCC, Madras group A have attended 10 NCC camps. The majority of them were RDC Camps. He participated in the Marina Republic Day Parade 2023 (MRDC) and won the best contingent shield. He received gold medal from Tamil Nadu, Puducherry and Andaman Nicobar Directorate (TNP&AN). Being an NCC cadet he was trained in activities like rappelling, shooting, etc.

Rappelling Adventure Training

MRDC Contingent 2023, Tamil Nadu Secretariat Office

Master **S. Matheshwaran** of II BSc Physics with Computer Applications has been practicing and teaching the art of karate at Champions Sports Karate Academy for the past 11 years. He participated in more than 100 karate tournaments and won several medals and trophies. He also conducting many karate camps at schools to teach them karate and self-defense techniques.

Gold Medal in Senior Kata; South Zonal Championship – 2023; Thiruvandrum, Kerala

Bronze Medal in Team Kata; National Karate Championship; Dehradun, Uttarkhand; 19.02.2023

# STUDENTS' PLACEMENT

| S. No | Reg Number/Roll Number | Name | Company | Pay Package at the Time of Appointment |
|---|---|---|---|---|
| 1 | 1913101084113 | Monish R | Wipro, Chennai | Rs. 5 L |
| 2 | 1913101084104 | Gokul Krishnan M | AccessHealthcare, Chennai | Rs. 2.79 L |
| 3 | 1913101084119 | Ranjith Kumar D | NielsenIQ, Chennai | Rs. 3.46 L |
| 5 | 1913101084122 | Rutesh G | AccessHealthcare, Chennai | Rs. 2.79 L |
| 6 | 2013102072121 | Sherin Celshia | Omega Healthcare, Chennai | Rs. 1.8 L |
| 7 | 2013102072104 | Gopi Krishna KR | Nanoampere Materials Pvt Ltd, Chennai | Rs. 1.44 L |
| 8 | 2013102072106 | Karthick N | Guidehouse, Chennai | Rs. 3 L |
| 9 | 20E3123 | Suruthi B | Accenture, Sholinganallur, Chennai | Rs. 2.16 L |
| 10 | 20E3106 | Swetha S | ST. Joseph's Nursery and Primary School, Amattur, Chennai | Rs. 1.2 L |
| 11 | 21E4512 | Shalima Ajkumar | Accenture | Rs. 3.25 L |
| 12 | 21E4507 | Kanishka Sharma R | Accenture | Rs. 3.25 L |
| 13 | 21E4501 | Amirtha Varshini | Accenture | Rs. 3.25 L |
| 14 | 21E4504 | Madhu G | Accenture | Rs. 3.25 L |
| 15 | 21E4506 | Hariesh AS | Weecon Company Pvt Ltd | Rs. 4.20 L |
| 16 | 21E4514 | Ajithkumar R | Weecon Company Pvt Ltd | Rs. 4.20 L |
| 17 | 21E4510 | Jeya Merci Bha S | Weecon Company Pvt Ltd | Rs. 4.20 L |
| 18 | 21E4519 | Muthukumarasamy S | Weecon Company Pvt Ltd | Rs. 4.20 L |
| 19 | 21E4523 | Revanth S | DAV Schools | Rs. 2.16 L |
| 20 | 21E4505 | Dhanoosh K | Tamil Nadu Mercantile Bank Limited | Rs. 3.65 L |

# STUDENTS' PROGRESSION

| Roll No | Roll No | Name of the Student | Name of Institution Joined | Name of Programme Admitted |
|---|---|---|---|---|
| MSc Physics | 21E4524 | Meena RM | Mangalam College of Education | B.Ed. |
| | 21E4502 | Sakshi S | Krishna College of Education | B.Ed. |
| | 21E4503 | Saranya S | GRT Educational Institute | B.Ed. |
| | 21E4526 | Subashree BR | Apollo College of Education | B.Ed. |
| BSc PCA | 20E3121 | Akash S | St Peter's University, Chennai | M.Sc. Computer Science |
| | 20E3104 | Arun P | Madras University, Chennai | MCA |
| | 20E3124 | Ashok Bhupathy KS | DG Vaishnav College, Chennai | M.Sc. IT |
| | 20E3117 | Dhikshitrathnam S | Jaya engineering college | MCA |
| | 20E3105 | Madhavan S | DDGD Vaishnav College, Chennai | M.Sc. Physics |
| | 20E3115 | Manoj Kumar C | SRM University, Chennai | MCA |
| | 20E3125 | Naveen Kumar K | St Peter's University, Chennai | M.Sc. Computer Science |
| | 20E3122 | Naveen T | Hindustan Institute of Technology, Chennai | M.Sc. Data Science |
| | 20E3101 | Pavithran | Madras University, Chennai | MCA |
| | 20E3120 | Sanjay R | Madras University, Chennai | MCA |
| | 20E3114 | Santhosh D | MGR University, Chennai | MCA |
| | 20E3126 | Thevanathan L | Madras University, Chennai | MBA |
| | 20E3102 | Vishvaa D | Madras University, Chennai | MBA |
| | 20E3111 | Vishruth Goswami | Australian National University | MSc Astrophysics and Astronomy |
| | 20E3103 | Keerthi M | Sastra Deemed University, Chennai | M.Sc. Data Science |

MoU

## MOUs SIGNED

| **MoU *between*** | **Date** | **Course** |
|---|---|---|
| Dwaraka Doss Goverdhan Doss Vaishnav College *and* A2B, Chennai | 28.11.22 | Placement Training Program |
| Dwaraka Doss Goverdhan Doss Vaishnav College *and* AICL, Chennai | 28.11.22 | Machine Learning Essential and Python for Data Science and Design Issues in ML |
| Dwaraka Doss Goverdhan Doss Vaishnav College *and* M/S Sindhujaa Academy for Science and Maths, Chennai | 28.11.22 | Advance Excel with Data Visualization & Power Bi<br>App Development |
| Dwaraka Doss Goverdhan Doss Vaishnav College *and* Ingu's Knowledge Academy Pvt., Ltd., ("SkillsDa") Chennai | 28.11.22 | Advanced Python, Basics of Kali Linux and Cyber Security |


Dwaraka Doss Goverdhan Doss Vaishnav College *and* Ingu's Knowledge Academy Pvt., Ltd., ("SkillsDa") Chennai


Dwaraka Doss Goverdhan Doss Vaishnav College *and* AICL, Chennai

Dwaraka Doss Goverdhan Doss Vaishnav College *and* Ingu’s Knowledge Academy Pvt., Ltd., (“SkillsDa”) Chennai


Dwaraka Doss Goverdhan Doss Vaishnav College *and* A2B, Chennai

# DEPARTMENT ACTIVITIES

## OUTLINE OF THE PROGRAMS

| S. No | Date | Department Activities |
|---|---|---|
| 1. | 16/8/2022 to 24/8/2022 | Prarambh 2022 – Student Induction Programme (UG) |
| 2. | 9/9/2022, 12/9/2022, 13/9/2022 | Deeksharambh – Student Induction Programme – 2022 (PG) |
| 3. | 15/9/2022 | Seminar-Nanomaterials and Its Applications |
| 4. | 23/9/2022 | Student Welfare Activity – Yoga for Youth Empowerment |
| 5. | 14/10/2022 | Guest Lecture I – Green Energy for the Future |
| 6. | 14/10/2022 | Guest Lecture II – Building a career out of your academic experiences – Unravelling the Mystery Behind Connecting the Dots better |
| 7. | 15/10/2022 | Student Welfare Activity – World Students Day |
| 8. | 25/11/2022 | Parents–Teacher Meeting |
| 9. | 3/2/2023 | Alumni Meet |
| 10. | 9/2/2023 | EVS Trip to Farm Guru, Solavaram, Tamil Nadu |
| 11. | 14/2/2023 | State Level Science Exhibition To commemorate National Science Day |
| 12. | 18/2/2023 | Industrial Visit to KEL, Cochin, Kerala |
| 13. | 24/2/2023 | National Level Workshop on DFT Calculation and Nanomaterial Characterization Techniques |
| 14. | 28/2/2023 | Radiate 2023 – An Intercollegiate Event |
| 15. | 15/03/2023 | Skill Enrichment on Electric Vehicle & its Battery Technologies |

## BRIEF REPORT OF THE ACTIVITIES

1. **Deeksharambh – Student Induction Programme – 2022 (BSc PCA)**

Date: 16.08.2022 to 24.08.2022

Post Graduate Department of Physics has organized "Deeksharambh – Student Induction Program Prarambh 2022" from 16th August 2022 to 24th August 2022. Eminent speakers were invited from various fields so as to motivate the students to develop their personalities. Mr. T. SelvaGanapathy interacted with students to develop their Entrepreneurship skills and imbibe the various industrial techniques. Mr. K. Manohar gave lively sessions on the topic "Yoga for Human Excellence" regarding how to lead a stress-free life which energy the students. Mr. R. Ajith Kumar gave lectures on "Judicious use of time". Activities like essay writing, painting, elocution, debate, reading books and pencil carving. Students actively participated and exhibited their skills. Students also participated in chess to showcase their extracurricular activities.

2. **Deeksharambh – Student Induction Programme Prarambh - 2022 (MSc Physics)**

Date: 09.09.2022, 12.09.2022 and 13.09.2022

The Post Graduate Department of Physics has conducted Student Induction Programme for I M.Sc. students to inspire them and lift their spirits during the course and in future. Mr. R. Shankar, RJ in Rainbow FM 101.4 MHz, All India Radio shared his experience about the career in media, after earning a degree. Mr. G. Gnanasambandan Assistant Director, Forensic Sciences Department, Chennai shared his extensive knowledge in forensic science with the students as well as his wisdom in life. Mrs. Sneha Prakash Head, HR & Administration Sundaram Business Services instructed the youngsters about the conduct in workplace and interaction with individuals after reaching a crucial juncture in their lives. After that, the students were encouraged to participate in a range of activities, including essay writing, debate and painting, to exhibit their skills.

3. **Seminar on “Nanomaterials and Its Applications**

Date: 15.09.2022


The main objective of the program is to expose the students to the concepts of Nanomaterials and make them easily understandable. The speaker Dr. S. Gokul Raj gave a presentation about nanomaterials, its synthesis methods, characterization techniques, types of nanotubes, advantages and disadvantages. He explained about the importance of nanomaterials. He highlighted the applications of nanomaterials.

4. **Student Welfare Activity – Yoga for Youth Empowerment**

Date: 23/9/2022

The objective of the programme is to explore the methods of Yoga and its benefits to the students. Dr. A. Kala, Assistant Professor, Department of Physics, Nandhanam Arts College for Men, Dr. JahiraParveen, Assistant Professor, College of Management, SRM Institute of Science and Technology and Mr. G. Achuthan, Professor in SKY Yoga, Chennai, were the resource persons. They taught the method of Yoga for nearly two and half hours which would be helpful to increase the concentration and memory power of the students. Students have participated enthusiastically, and they learnt a lot from them. The students have been inspired by the resources and they wanted to continue with the yoga practice to enrich their lives in all aspects.


5. **Guest Lecture I -Green Energy for the Future**

Date: 14.10.2022

Chief Guest Dr. B. Muthuraaman, Head and Assistant Professor, Department of Energy, University of Madras, Chennai, has delivered a lecture on the importance of Green energy in our daily life and their applications like solar energy, Wind energy, Hydro energy, Tidal energy. He also provided insight about the possibilities of research and development in Green energy. The recent works on Green energy and fabrication of polymer electrolytes based dye-sensitized solar cells prepared by their team were explained.


6. **Guest Lecture II-Building a career out of your academic experiences – Unravelling the mystery behind connecting the Dots better**

Date: 14.10.2022

The main objective of the program is to expose the students to the concepts of Building a career. The speaker Dr. Humeshkar Bhaskar Nemala gave a presentation about the life skills, time management, emotional intelligence, Resource management, people management, Risk management. He motivated students to do develop their skills.

7. **Student's Welfare Activity-World Students' Day**

Date: 15/10/2022

The PG Department of Physics has organized a Student Welfare Activity-World Students' Day in commemoration of Dr. A.P.J Abdul Kalam's Birth Anniversary. Our chief guest Dr. A. Stephen gave a special address on Development in Science and Research and our students gained knowledge about current ongoing research work through the program. The following competitions were held for the students in the PG Department of Physics. The winners were appreciated with memento and certificates

i. Writing Competition – Topic: Inspiring books Written by Dr. A. P. J. Abdul Kalam
ii. Oratorical Competition – Topic: Turning points of Dr. A. P. J. Abdul Kalam: A Journey through challenges
iii. Drawing Competition – Topic: Dreams of Dr. A. P. J. Abdul Kalam
iv. War of Words (Debate) –Topic: Role of Dr. A.P.J. Abdul Kalam: Scientist Vs President


8. **Parents Teacher Meeting**

Date: 25/11/2022

Parents Teacher Meeting was organized on 25.11.2022 from 2.00 p.m to 6.00 p.m for I PCA and I M.Sc. class students. We had a very good interaction with parents. We collected feedback form from parents. Most of the parents were happy for their wards to be in this college. This meeting helps to understand better about student's activities at home and helps to take remedial measures in developing student's knowledge level.

9. **Alumni Meet**

Date: 03.02.2023

Post Graduate Department of Physics has organized "Alumni Meet" for UG and PG Students on 03.02.2023. Welcome Address was given by Dr. B. Sylaja, Head i/c, Assistant Professor, PG Department of Physics. Alumni Students had a very good interaction and discussed more about current opportunities. We conducted many activities to alumina to make the session memorable. Gifts were given to all Alumni as token of appreciation. Vote of Thanks was delivered by Dr. K. Annapoorani, Assistant Professor, PG Department of Physics.


10. **EVS Trip**

Date: 09.02.23

Two staff along with 30 II BSc PCA students started from college at 8.45 am and reported at Farm Guru at 10 am. Introduction about Farm Guru were given to students. Students have done many activities like ploughing, sowing, transplanting, harvesting, threshing, pounding & winnowing. Session on organic farming & food security were taken. Students went for bullock cart and tractor ride. Organic lunch was provided to the students. Post-lunch students had fun at the chill water fall. Students were given a session on modern techniques of farming. Then staff and students returned back to college at 5 pm.

11. **State Level Science Exhibition to Commemorate National Science Day "*Atoms in the Service of Mankind*"**

Date: 14/02/2023

The PostGraduate Department of Physics, Dwaraka Doss Goverdhan Doss Vaishnav College (Shift II) organizes a State Level Science Exhibition to Commemorate National Science Day "Atoms in the service of Mankind" on February 14, 2023 Co-Sponsored by Tamil Nadu State Council for Science and Technology in association with Indira Gandhi Centre for Atomic Research, Department of Atomic Energy, Kalpakkam. The following nuclear models are displayed in the exhibition.

1. 2-D LED working models of fission reaction and DAE establishments in India using India map
2. 3-D LED models on PHWR 700 MWe
3. FBTR and FBTR fuel pins
4. KAMINI
5. Safety Grade Decay Heat Removal System (SGDHRS)
6. Bhabhatron
7. Gamma Chamber 5000
8. PFBR GRID Plate and standee display panels on irradiation technology used in
    - ➢ Agriculture and Food preservation
    - ➢ Water Technology and Sewage treatment.
    - ➢ Power plants of NPCIL in India through India Map, and about Indian research reactors
    - ➢ Industrial application and Heavy water Board.

Physics Working Models done by UG and PG Students of PG Department of Physics, DDGD Vaishnav College, Arumbakkam, Chennai are displayed.

12. **Industrial Visit**

Date**:** 18-02-2023

With the specific objectives of exposing the students to the latest technology, machinery and good industrial practices, PG Department of Physics has organized an Industrial Visit for the I and II year M.Sc. students to **Kerala Electrical & Allied Engineering Private Limited, Mamala, Cochin**. Thirty-six PG students along with four faculties visited the industry. Really, that was a wonderful experience to the students. KEL is a Transformer manufacturing Industry. It is manufacturing Power distribution transformers and supplying them to all over India. In the last year itself, it has supplied 5000 Transformers to our state Tamil Nadu. The Engineers over there explained very well about the manufacturing process of the transformers Students have been really excited to gain a complete practical knowledge about the manufacturing of the transformers.

13. **National Level Workshop on DFT Calculation and Nanomaterial Characterization Techniques**

Date: 24.02.2023

The main objective of this workshop is to provide a platform for researchers, educators and students to discuss the evolving developments in materials. This workshop elucidates the principles of material synthesis and characterization of Nanomaterials and also emphasis hands-on training in electric vehicles batteries and their analysis techniques using battery lab software. This workshop intends to introduce the basic concepts in Density Functional Theory and provides hands-on training in quantum chemical computation using DFT.

The following guests were invited and hands – on training was provided for the participants in the workshop.

1. Dr. S. Gokul Raj: Material Synthesis and Characterization of Nanomaterials
2. Dr. Arjunan Ponnaiah: Electric vehicle batteries and their analysis techniques using battery lab software
3. Dr. V. Ragavendran: An Introduction to Density Functional Theory and Hands on training in Quantum Chemical Computation using DFT
4. Dr. N. Kanagathara: Hands – on training in Quantum Chemical Computation using DFT


14. **Radiate 2023 - Intercollegiate Event**

Date: 28/2/2023

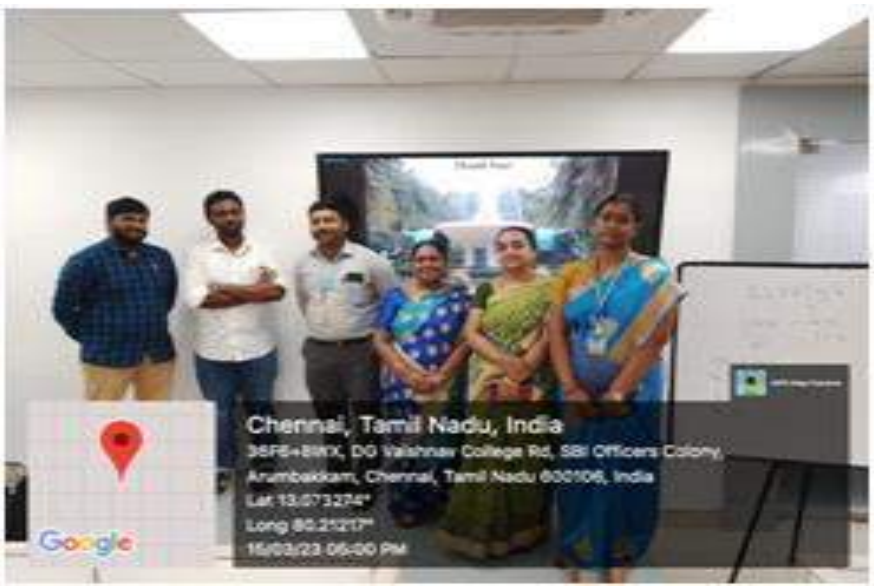
RADIATE 2023, an intercollegiate event, was organized by Post Graduate Department of Physics on 28th February 2023. Ariviyal Mudhu Munaivar, S. Gunasekaran Ph.D., D.Sc. TANSA Awardee, Dean R&D, St. Peter's Institute of Higher Education and Research, was the Chief Guest. Our Principal Captain Dr. S. Santhosh Baboo sir felicitated the chief guest. The welcome address was delivered by Head i/c Dr. B. Sylaja. The inaugural address was delivered by Dr. S. Gunasekaran. Sir has inspired the students with his thought-provoking motivational Speech. Events like Rivalry of Witz, Razzmatazz, Potpourri, War of Words, Words of Intuition and view through Concave were conducted. Dr. S. Srinivasan, Assistant professor from Presidency College presided over the Valedictory function. Prizes have been distributed to the winners of the events.


GPS Map Camera
Chennai,TN,India
Arumbakkam, Chennai, 600106, TN, India
Lat 13.075338, Long 80.212693
02/28/2023 06:05 PM GMT+05:30
Note : Captured by GPS Map Camera

15. **Skill Enrichment on Electric Vehicle & its Battery Technologies**

Date: 15/03/2023

The chief guest Dr. Aravind Kumar Chandiran, Associate professor, Department of chemical Engineering, IIT Madras delivered a talk about Skill Enrichment on Electric Vehicle & its Battery technologies for the benefit of student community. The students interacted with him about the present and future scenario of electric vehicle and the various technologies involved for the production of electric vehicle batteries.



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