



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
Kakinada-533003, Andhra Pradesh, India

**M.Tech in Nanotechnology**

**Global Outcome :**

Nanotechnology has potential applications in every industrial sector, from medicine to clean water and energy, thereby promising opportunities for enabling radical changes in the lifestyles of populations around the globe. It is often seen as one of the most promising, cutting-edge, and disruptive technological breakthroughs of the last few decades.

**National outcome:**

One possible means of bridging the gap between India's abundant, varied natural resources and however-increasing requirements like clean water, food ,rapid, low cost diagnostic machinery uses Nanotechnology. Self-reliance in nanotechnology can make good use of the natural and human resources in India and also help India self-reliant in sectors like defence and anti-terrorism.

**Local Outcome :**

To attain the needs/ problems of local areas like East Godavari in Andhra Pradesh has many challenges like soil pollution, ground water and surface water pollution due to agricultural and aqua culture practices, waterborne diseases in rural areas and coastal areas due to unsafe drinking water, effluents from industrial and urbane waste, corrosion effect on local boats/ships and sea port area in Kakinada, nanotechnology plays a major role.

Nano based fertilizers, filtration, catalysis and anticorrosive coating researches are best possible way for Soil pollution, waterborne diseases, waste treatment and Marine practices respectively

**PROGRAM OUTCOMES:**

- PO1 To develop trained manpower in the field of Nanotechnology with specific emphasis for exploitation of Nanotechnology looking at the demand/need of changing trends of modern Industries.
- PO2 To amalgamate traditional research for Nanotechnology with advanced cutting-edge technologies for product development and manufacturing such as NEMS, MEMs, Nano drugs, lab on chip concepts, etc.
- PO3 To introduce the powerful tools of Nanotechnology for R&D with a rigorous attention to device fabrication.
- PO4 To exposure National & International research in the field of Nano Science and Nanotechnology.

**COURSE OUTCOMES**

Course Code	<b>Introduction to Nanomaterials and Applications</b>
<b>M9601</b>	

After completion of course, students would be able to:

- C01 Student can able to theorize the importance of crystal structure for property evaluation.
- C02 Student can assess different types of chemical bonding in materials.
- C03 To evaluate nano structures in quantum mechanical approaches.
- C04 Students can able to distinguish between classical electromagnetic theory and Quantum Mechanics.



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Course Code	<b>Synthesis of Nanomaterials</b>
<b>M9602</b>	

After completion of course, students would be able to:

- C01 To develop knowledge about the electronic properties of semiconductor devices.
- C02 To construct the magnetic properties of bulk Nano structured materials.
- C03 To visualize the effect of optical properties of various materials
- C04 Students can able to acquire knowledge based on the physical, chemical and biological methods of synthesis of nanomaterials

Course Code	<b>Thin Film Science and Technology</b>
<b>M9603</b>	

After completion of course, students would be able to:

- C01 To develop deep understanding on Vacuum Technology.
- C02 To compile all the Conditions for formation of thin films
- C03 To know the importance of Physical Vapor Deposition techniques.
- C04 To prioritize the role of Electrical discharges used in Thin Film Deposition
- C05 To improve the understanding of deposition using CVD.

Course Code	<b>Nanomaterials for Energy Systems</b>
<b>M9604</b>	

After completion of course, students would be able to:

- C01 Study the basic Energy need and role of Battery materials
- C02 To grade up knowledge of Super Capacitors, and its Applications.
- C03 Study the role of nano structured material to meet Energy Challenges.
- C04 Learn about the concept of Hydrogen Storage Technology.
- C05 Gain knowledge on role of Fuel Cell Technology.
- C06 Gain knowledge on Microfluidic Technology.

Course Code	<b>Nano Photonics &amp; Plasmonics</b>
<b>M9605</b>	

After completion of course, students would be able to:

- C01 To extend the knowledge on Nano photonics and Plasmonics
- C02 2. To study about quantum confined materials, photonic crystals, and Nanophotonic devices

Course Code	<b>Nano fluidics</b>
<b>M9606</b>	

After completion of course, students would be able to:

- C01 To make students understand the fundamentals of nanofluids and different synthesis methods
- C02 To make understand conduction heat transfer and convection in nanofluids
- C03 To familiarize the theoretical modeling of thermal conductivity of nanofluids.
- C04 To make understand boiling of nanofluids



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Course Code	<b>Nanoscopic Dielectric and Ferroelectric materials</b>
<b>M9607</b>	

After completion of course, students would be able to:

- C01 To make students understand the fundamentals of piezo electric nanomaterials, their preparation methods, properties and applications
- C02 Students understand the fundamentals of pyro electric nanomaterials, their preparation methods, properties and applications

Course Code	<b>Carbon Nanostructures and Applications</b>
<b>M9608</b>	

After completion of course, students would be able to:

- C01 Students can develop understanding of carbon clusters, fullerenes and carbon nanotubes
- C02 Students understand synthesis methods of carbon nanotubes, and their applications
- C03 Students can develop knowledge about graphene and graphene like nanostructures

Course Code	<b>Research Methodology &amp; IPR</b>
<b>M0109</b>	

After completion of course, students would be able to:

- C01 Understand research problem formulation.
- C02 Analyze research related information
- C03 Follow research ethics
- C04 Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- C05 Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- C06 Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

Course Code	<b>Nanomaterials Synthesis Lab</b>
<b>M9609</b>	

After completion of course, students would be able to:

- C01 Gain knowledge on the physical, chemical and biological synthesis techniques involved in experiments.
- C02 To fabricate thin films using spin coating and spray pyrolysis equipments
- C03 To construct a theoretical knowledge on the experiments.
- C04 The ability to write and present the laboratory reports.
- C05 To maximize knowledge regarding synthesis of nanomaterials



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Course Code	<b>Nanomaterials Simulation lab</b>
<b>N9610</b>	

After completion of course, students would be able to:

- C01 To understand how to build atom by atom carbon based nanostructures using simulation methods.
- C02 To obtain a theoretical knowledge on the simulation experiments
- C03 To gain ability to write and present laboratory reports

Course Code	<b>Writing Skills for Scientific Communication</b>
<b>MAC12</b>	

After completion of course, students would be able to:

- C01 Understand that how to improve your writing skills and level of readability
- C02 Learn about what to write in each section
- C03 Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Code	<b>Nanomaterials Characterization Techniques</b>
<b>N9601</b>	

After completion of course, students would be able to:

- C01 To evaluate the spectroscopic characterization techniques of nano materials.
- C02 To compare various compositional and structural characterization techniques.
- C03 To infer the importance of advanced characterization techniques.
- C04 Student can able to develop knowledge about various electrical and magnetic characterization techniques.
- C05 Gain overall knowledge of various thermal and magnetic characterization techniques.

Course Code	<b>Nano Sensors and its Applications</b>
<b>N9602</b>	

After completion of course, students would be able to:

Students get exposure on Nano scale based inorganic sensors, thermal sensors, biosensors, and their applications in addition to sensor characteristics and physical effects.

Course Code	<b>Biomedical Nanotechnology</b>
<b>N9603</b>	

After completion of course, students would be able to:

- C01 To familiarize students with biological systems, materials and building blocks.
- C02 To understand the concepts of Biological Nanostructures
- C03 To familiarize about Biomedical Applications.
- C04 To prioritize the role of nano structured materials in diagnosis
- C05 To gain the improvements in drug delivery system using nanotechnology.
- C06 To study various Nanopharmacology & Drug Targeting and drugs delivery systems

Course Code	<b>Nanocomposites and Applications</b>
<b>N9604</b>	

After completion of course, students would be able to:

- C01 Student can able to discuss the basic concepts of Nano Composites.
- C02 Student can able to prioritize the role of Ceramic Metal Composites in Nano Technology.
- C03 To understand the role of Synthesis Methods for various Nano Composite materials.



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- C04 Learn about the concepts of Indentations and types of Indentations.
- C05 Correlate the applications of Polymer Nano Composites and Impregnation Techniques.

Course Code	<b>Computational Nanotechnology</b>
<b>N9605</b>	

After completion of course, students would be able to:

- C01 To make students understand the basics of mechanical and statistical computational techniques
- C02 To familiarize students with Atomistic, Molecular dynamics, Monte Carlo and Mesoscale simulation techniques to evaluate different properties of nanomaterials

Course Code	<b>Nanoscale Magnetic Materials and Devices</b>
<b>N9606</b>	

After completion of course, students would be able to:

- C01 To extend the knowledge on Nanoscale magnetic materials, hard and soft magnetic materials and measurement techniques of magnetization.
- C02 To study about Biomagnetism, Biomagnetic nanostructures and biomedical applications of magnetic materials.
- C03 To gain knowledge on ferrofluids, magnetoresistance and MRAM applications

Course Code	<b>MEMS and NEMS</b>
<b>N9607</b>	

After completion of course, students would be able to:

- C01 To provide understanding of MEMS/NEMS applications specially sensors, and actuators, Micro machining tools etc.,
- C02 To provide materials for MEMS/NEMS and material structures.
- C03 To provide information on MEMS/NEMS design, processing and Technologies
- C04 To bring out scaling and packaging issues of MEMS
- C05 To understand different lithographic techniques of fabrication

Course Code	<b>Multifunctional Nanomaterials</b>
<b>N9608</b>	

After completion of course, students would be able to:

- C01 To assess knowledge on specific multifunctional nanomaterials and smart materials, their properties and applications.
- C02 To understand specific multifunctional nanomaterial like TiO<sub>2</sub> for water purification as photocatalyst.
- C03 To assess how nanoparticles are used for the treatment of Arsenic
- C04 To develop synthesis strategies of specific multifunctional nanomaterials

Course Code	<b>Characterization Lab</b>
<b>N9609</b>	

After completion of course, students would be able to:

- C01 Gain knowledge on the Dynamic Light Scattering, AFM, SEM, Raman Spectroscopy and Differential Scanning Calorimetry
- C02 To construct a theoretical knowledge on the experiments.
- C03 To analyze results of X-Ray diffraction, UV-Visible Spectroscopy and TG/DTA apparatus
- C04 The ability to write and present the laboratory reports.
- C05 To maximize knowledge regarding Characterization of nanomaterials.



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Course Code	<b>Advanced Nanotechnology Lab</b>
<b>N9610</b>	

After completion of course, students would be able to:

- C01 To impart the basic knowhow in connection with the fabrication of solar cells.
- C02 To provide practical knowledge for performance evaluation of Lithium-ion based materials
- C03 To perform the anti-microbial tests.
- C04 To detect the various gases using nanosensors.
- C05 To evaluate the photocatalysis process.

Course Code	<b>Societal Impact of Nanotechnology</b>
<b>P9602</b>	

After completion of course, students would be able to:

- C01 To provide awareness to the engineering students about socio economic impact of nanotechnology and to handle the techniques effectively .
- C02 Understand the various social impacts of nanotechnology trend and research
- C03 To enhance the nanotechnology research by taking ethics and public opinion into consideration.
- C04 To understand of professional and ethical responsibility.

Course Code	<b>Nano electronics</b>
<b>P9603</b>	

After completion of course, students would be able to:

- C01 To assess knowledge on Single Electron and few Electron phenomenon.
- C02 To determine theory behind Scanning Tunneling Microscope by Applications of Tunneling.
- C03 Study the basics of coulomb blockade in Quantum mechanics.
- C04 To persuade Single Electron Transistor and Carbon Nano tube Transistor.
- C05 To extend the knowledge on Spintronics.

Course Code	<b>Nanotechnology and its Engineering Applications</b>
<b>POE62</b>	

After completion of course, students would be able to:

- C01 Student can able to theorize the importance of crystal structure for property evaluation.
- C02 Student can assess different types of chemical bonding in materials.
- C03 To evaluate nano structures in quantum mechanical approaches.
- C04 Students can able to distinguish between classical electromagnetic theory and Quantum Mechanics.

Course Code	<b>Nano sensors and Applications</b>
<b>POE63</b>	

After completion of course, students would be able to:

- C01 Students get exposure on Nano scale based inorganic sensors, thermal sensors, biosensors, and their applications in addition to sensor characteristics and physical effects.

Course Code	<b>NEMS and MEMS</b>
<b>POE64</b>	

After completion of course, students would be able to:

- CO1 To provide understanding of MEMS/NEMS applications specially sensors, and actuators, Micro machining tools etc.,
- CO2 To provide materials for MEMS/NEMS and material structures.



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- CO3 To provide information on MEMS/NEMS design, processing and Technologies.  
CO4 To bring out scaling and packaging issues of MEMS.  
CO5 To understand different lithographic techniques of fabrication.

Course Code	<b>Nanotechnology for energy system</b>
<b>POE65</b>	

After completion of course, students would be able to:

- CO1 Study the basic Energy need and role of Battery materials  
CO2 To grade up knowledge of Super Capacitors, and its Applications.  
CO3 Study the role of nano structured material to meet Energy Challenges.  
CO4 Learn about the concept of Hydrogen Storage Technology.  
CO5 Gain knowledge on role of Fuel Cell Technology.  
CO6 Gain knowledge on Microfluidic Technology.