



Professional Postgraduate Program in Nanotechnology (with focus on Nanoelectronics) (PPGP-NT)

(Autonomous, full-time, 11 months, residential Program in association with **National Laboratories**)

Nanoelectronics is where physics, material science, chemistry, electrical and electronics engineering converge. Today's commercial transistors are well below 100 nanometer in size and are therefore entering the nanoworld. The tremendous miniaturization in electronic devices has not only led to increased capacity and performance, but also to the discovery of new phenomena and applications. It is obvious that Moore's Law cannot hold forever, at some moment the fundamental limits set by nature awaits us. Getting a grip on the fundamental properties of Nanoelectronics devices is therefore of crucial importance and, at the same time, a very exciting scientific challenge. Considering this the Program has a strong focus on exploring the possibilities of different Nanomaterials for different types of Nanodevices.

This 11 month, full-time, Professional Postgraduate Program in Nanotechnology with focus on Nanoelectronics is an opportunity for the students to establish an international research career with focus in:

- Nanotechnology
- Nanomaterials
- Nanoelectronics

Distinctive Features:

- Well-structured theory and laboratory sessions
- Collaboration with leading universities and research institutes in South Korea and India to complete the Projects
- Expert lectures, seminars and case studies by leading experts from Research Institutes

Eligibility:

Graduates / Postgraduates with a Bachelor's Degree in Engineering / Technology in Electrical / Electronics / Communication / Chemical / Mechanical or MSc Physics / Electronics / Chemistry or equivalent (with minimum 50 percent marks or equivalent grades). Basic Knowledge of Material Science and Electronics

Curriculum:

NE501 Physical Science for Nanotechnology (80 Hours): Atomic Physics. Quantum and Statistical Physics. Solid State Physics. Introduction. Nanomaterials. Various Nanostructures. Carbon Based Nanostructures. Properties of Nanomaterials. Approach for Synthesis of Nanomaterials. Special types of Nanomaterials. Applications of Nanotechnology. Latest trends in Nanotechnology. Molecular Nanoelectronics. NEMS Introduction

NE502 Nanochemistry (80 Hours): Basic Concepts in Chemistry. Chemical Aspects of Nanotechnology. Synthesis Method of Nanomaterials. Physical Chemistry of Solid Surfaces. Zero-Dimensional Nanostructures: Nanoparticles. One-Dimensional Nanostructures: Nanowires and Nanorods. Two-Dimensional Nanostructures: Thin Films. Special Nanomaterials. Nanostructures Fabricated by Physical Techniques. Characterization and Properties of Nanomaterials. Applications of Nanomaterials

NE503 Nanomaterial Characterization (80 Hours): X-ray Diffraction (XRD). Electron Microscopy. Scanning Probe Microscopy. UV-Visible Spectroscopy (UV-Vis.). Fourier Transform Infra-red Spectroscopy (FT-IR). Raman Spectroscopy Surface characterizations. X-ray Photo-electron Spectroscopy (XPS). Thermal Characterizations. Thermo-gravimetry Analysis (TG-DTA). Differential Scanning Calorimetry (DSC). Magnetic

Characterizations

NE504 Nanoelectronics Fundamentals (80 Hours): Crystal Structure of Solids. Metal Semiconductor and Heterojunctions. Bipolar Transistors. Memory applications Comparison of Data storage (write once, rewritable) Phase-change materials and DVD-RW. Ferromagnetic and Ferroelectric Materials. Magnetic Energy and States Hard disk drive. Current and Future media Magnetoresistance and Hard disk Drive read head Novel RAM (Ferroelectric, Phase-change, Magnetic). Probe-based Storage (Millipede). Logic applications MOSFET and Logic Functionality (nano) MOSFET. Scaling Schottky Barrier. MOSFET Molecular Electronics. Spintronics. Discussion on Quantum Computing.

NE601 Experimental Techniques for Nanotechnology (80 Hours): Synthesis of Nanomaterials. Chemical Methods. Sol-gel. Spray-Pyrolysis. Microwave Solvothermal. Physical Methods. Plasma Synthesis. Laser Ablation. Synthesis of Nanocomposites. Application exploration

NE602 Nanoscale Processing and Characterization for Devices (80 Hours): Silicon Processing Methods. CVD. Nanolithography. Molecular Beam Epitaxy. MOCVD, Processing III- V Semiconductors. RF-Plasma Methods. Si-Ge. SiC Diamond. Bottom-Up-Approach. Role of Surfaces in Nanotechnology Devices Characterization.

Project:

NE701 Project (620 Hours): Students in this course should take up a sponsored project or a research-based thesis at leading research institutes. The research project includes researching on the given/chosen seminar topic which will generally be state-of-the-art in the field and then deliver the seminar to peers and faculty along with its documentation in the prescribed format. Following the seminar the student has to undertake a research project under the guidance of tenure track/visiting faculty and researchers. The research project has to be submitted in the form of a dissertation, which will be examined by experts nominated by the Institute. The research project is the culmination of the student's learning in the Institute and is expected to be of high standards as demanded by the research fraternity from time to time.

Program Structure:

Term / Duration	Subject Code	Subject Name	Hours
Term-1 (Twenty Weeks)	NE501	Physical Science for Nanotechnology	80
	NE502	Nanochemistry	80
	NE503	Nanomaterials Characterization	80
	NE504	Nanoelectronics Fundamentals	80
	NE601	Experimental Techniques for Nanotechnology	80
	NE602	Nanotechnology Processing and Nanodevice Characterization	80
Term - II (Twenty Three Weeks)	NE701	Project /Thesis	620
			Total Hours: 1100