NSTC

A Nanotechnology platform

Nanoelectronics & Its Industrial Applications

A Distance Participation Program

With e-learning Management System

Nano Science and Technology Consortium

Consulting . Research . Outsourcing . Technology

www.nstc.in/programs

NSTC: An Overview

NSTC is a non-governmental body, which came into existence in the year 2005. It aims to provide the services that lead to awareness creation, research and development, consultancy, collaborations, technology transfer and commercialization of budding Nano-based technologies. NSTC With over 250 corporate and industrial members has positioned itself as a unique and dependable resource for providing quality Nanoscale science and technology education through trainings. NSTC also runs India's only primary journal in the field of Nanotechnology, entitled "NanoTrends".

Program Overview

For the budding engineers and professionals it is very important to know and understand the latest that when they join the industry they are capable of giving back to the industry what they have learned and gained during their academic pursuits.

Currently Science & Technology based research has been transformed because of inventions and innovations been made in the field of visualizations, characterization, synthesis, materials & ability to commercially manufacture at 10^{-9} m scale level.

At the dimension of 10^{-9} m (billionth of a meter) the ability to create new and wonderful products and materials gets a tremendous boost, this is because at this scale we have the ability to work at atomic or molecular level and thus able to create things which are remarkably significant to current comparisons.

The Program **Nanoelectronics & Its Industrial Applications** is an advanced program meant to enhance the knowledge base of participants in the area of electronics. It enables the participant to be able to understand the various processes and business aspects of nano scale technology in electronics from the point of view of the industry.

The program comprises of nine modules. The modules include online tutorials and assessments, and are evaluated through project work and online assignments. The program consists of two online mid-term assignments, a final online examination and project work. The mid-term assignments contribute 20% to the final marking. The final online examination contributes 30%, and the project work makes up 50% of the final marks.

Program Aim

The innovative Program **Nanoelectronics & Its Industrial Applications** aims to give participants a thorough grounding in the skills necessary for a technology-based career in industries.

The course covers technologies used to design, realize and analyze micro and nano-scale electronic devices, materials and systems, coupled with general and technology management. This is supported by project work and ensures the graduates to emerge training in a wide range of technical and management skills, and have a sharp appreciation of the relevance of the subject to industrial needs.

Program Outcome

Successful students will secure positions in the newly developing Nano scale systems and technology-based

electronic industries as well as more traditional industries, such as microelectronics and precision engineering. Graduates will be able to pursue careers in a diverse range of electronics industries.

Program Structure

This structure combines flexibility with integration of the separate components right from the fundamental level to the high-end applications thereby providing a holistic view of the whole gamut of Nanotechnology in electronic industries.

Module 1: Fundamentals of Nanotechnology

1. **Historical Aspects of Nanotechnology:** Pre-18th Century, 19th Century, 20th Century, 21st Century
2. **What are Nano & Nanometer:** Nano dimension, The Nanometer
3. **Nanoscience & Nanotechnology:** Definitions & Components: Nanoscience, Nanotechnology

Module 2: Nanomaterials -Concepts & Fundamentals

1. **Introduction to Nanomaterials:** Historical background, Lessons learnt from nature, the future.
2. **Classification of Nanomaterials:** Introduction, Nature of origin
3. **Properties of Nanomaterials:** Quantum size effects, Anomalous crystal structure, Physical properties of nanomaterials, Anomalous phase transition, Thermal properties of nanomaterials, Charge and quantum transport in nanomaterials, Electrical Properties of Fullerenes, Optical Properties of Fullerenes, Chemical Reactivity of the Nanomaterials.

4. **Applications of Nanomaterials:** Molecular Electronics, Molecular switches, Carbon Nanotube based field effect transistors, Electron Field Emission Cathodes, Solar cells and Photovoltaic devices, Quantum well devices, Quantum well lasers, Heterojunctions Bipolar Transistor, Photonic crystals, Nanomaterials in Biology.

5. **Health Hazards of Nanomaterials:** Parameters determining toxicity, Uptake of nanomaterials and harmful effects.

Module 3: Nanostructures: Concepts & Fundamentals

1. **Zero Dimensional Nanostructures:** Nanoparticles

2. **One Dimensional Nanostructured:** Nanorods

3. **Two Dimensional Nanostructures:** Thin Films

4. **Some Other Nanostructures:**

- Quantum Heterostructures
- Nanofabrics
- Nanocapsules
- Dendrimers
- Nanoshells
- Nanocages
- Nanoflowers
- Nanofoams
- Nanofibers
- Nanomesh

- Nanotubes
- Fullerenes
- Nanocomposites

Module 4: Semiconductor Nanostructures & Nanomaterials

1. **Introduction**
2. **Importance of Semiconductor Nanomaterials in Electronic Industry**
3. **Various Silicon Nanostructures**
   - Silicon Nanowires
   - Silicon Quantum Dots
   - Carbon Nanotubes
   - Carbon Quantum Dots

Module 5: Carbon Nanotubes- Technology & Applications

1. **Introduction:** Introduction of Carbon Nanotubes
2. **Technology and Applications:** Types of carbon nanotubes, Chemistry and physics of carbon nanotube, Properties of carbon nanotubes, Industry wise applications of carbon nanotubes, Synthesis/production of carbon nanotubes, Characterization tools for carbon nanotubes, CNT Technology development in India and World
3. **Patents and Scientific Literatures:** Patents, Scientific literature

4. **Support for CNT Research and Challenges:** Worldwide, Indian context, Environmental, health and safety issues

5. **Industries Involved in the Production of CNTs:** List of companies involved in the Production of Carbon Nanotubes.

Module 6: Nano Scale Synthesis & Fabrication

1. **Epitaxial Growth:** Set-ups of MBE, Analyzing Techniques, Examples of Epitaxial Film with Growth Mechanism, Electronic Properties of Epitaxial Materials, Future Directions

2. **Self-Assembly:** Principles of Self-Assembly, Self-Assembly of Nano Metals, Self-Assembly of Compounds, Efficiency of Self-Assembly, Applications

3. **Top Down And Bottom Up Approach:** High-Energy Ball Milling as Top down Approach, Bottom-Up Approach, Examples of System Using Bottom-Up Approach

4. **Hybrid Techniques And Materials :** Nanoparticles as Radio sensitizers for Cancer Therapy, Techniques, Materials, Applications

Module 7: Nano Scale Characterization & Manipulation

1. **Nanomaterials Characterization:** Transmission Electron Microscope (TEM) , Scanning Electron Microscope (SEM), X-ray Diffraction (XRD) , Atomic Force Microscopy (AFM), Investigation of the Surface Charge Nanomaterials by Zeta-Potential, Thermal Stability by Thermogravimetric Analysis (TA) and Differential Scanning Calorimetry (DSC), Nano Tensile Tests, Dynamic Mechanical Analysis (DMA),Structural Characterization of Nanomaterials, Scanning Tunneling Microscope (STM)

2. **Molecular Nanomechanics:** Molecular Dynamics (MD), Nanomechanics of CNT, Bridging Scale Method, Nanomechanical Biosensors, Nanomechanics of Adhesion Proteins, Nanotribology and Nanomechanics, Nanomechanics in Natural Fibers

3. **Nanomanipulation and Nanolithography:** Template Fabrication, Micro Electromechanical Systems (MEMS), Nano-Electromechanical Systems (NEMS), Catalytic Technology, Why Manipulation of Nano Materials Required, Manipulation of Nano Materials by Dieclectrophoresis

4. **Nano Computation:** Faceted Melt/Crystal Interfaces, Nano-materials Design for High-TC Ferromagnetism, Computer Simulation for the Interaction of Nano-Materials, Multiscale Nano-Computation for Solidification Phenomena

Module 8: Nanoelectronics: Present & Future Aspects

1. **Electronic Market**

2. **Introduction and Importance of Quantum Mechanics**

3. **Present state of Nano-Electronics**

4. **Single-Molecule Electronics:** Molecular electronics, Molecular logic gate, Molecular wires

5. **Solid State Nanoelectronics:** Nanocircuitry, Nanolithography, Nanosensors

6. **Silicon Nanotechnology:** CMOS Nanotechnology, Ballistic Properties, Memory

7. **Carbon Nanotubes Electronics:** Carbon Nanotube Transistors
8. **Nano Emissive Display Devices**
9. **Quantum Dots**
10. **Nano chips**
11. **Use Electron Beam to Unravel the Secrets of an 'Atomic Switch'**
12. **Nano wire** : Growing Glowing Nan wires to Light up the Nanoworld
13. **Emergence of Electronic Nano Computers**
14. **Notable Achievements in Nano Electronics**

- Fabrication of a Self-Assembled Molecular Electronic Circuit Array
- Quantum Dot Cell and wireless Electronic Computing
- Fabrication and Testing of Quantum Corrals
- Construction and Demonstration of the Nanomanipulator
- Printing of Nanostructures Using Self-Assembling
- Molecular Monolayers
- Formation of the ULTRA Electronics Research Programme
- Fabricating Hybrid Nanoelectronic- Microelectronic Logic
- Room-Temperature Manipulation of Individual Molecules

- Arrays of Micro-STMs and Micro-AFMs

15. Nano Electro Mechanical System (NEMS)

16. Future of Nanoelectronics

Module 9: Electronic Consumer Products Manufactured using Nanotechnology

1. Computer Hardware

- Flash Memory Chip
- Processors
- Hard Disk Drive
- Cellular Memory cards
- Wireless Laser Mouse
- Laser Travel Mouse
- Wireless Keyboard
- iPod memory chips
- Conductive inks use in printed electronics
- Random access memory chip
- Anti bacterial coating of keyboard, skins of Laptop
- Cooling fan of Laptops
- Cartridge for inkjet and laser printers

2. Display

- Transparent Conductive Films

- OLED screens in Mobiles
- Television Displays

3. Mobile Devices and Communications:

- iPhones
- Mobile Memory cards
- Mobile flat panel displays
- Anti germs, antibacterial and anti mold mobile phone
- Cell Battery

4. Audio

- Hearing Aid
- Guitar Strings
- iPod
- Car stereo displays

5. Camera and Films

- Camera Lenses
- Mobile Phone image sensors
- Photo Paper

Online Tutorials

The training imparts through new online tutorial applications by which participants are guided on the program ingredients 24x7 times. Participants can work on their project topic according to their ease at college, home, office or where internet connection is possible. User id and password are provided to access this

system which is more secured. One can share their views about the program and project with other participants and can be self evaluated regularly. Additional activities perform by participants such as quiz participation, submissions of views about topic and online assignments.

Program work is completed through online system under the guidance of program coordinator

Study Material

Study Material is delivered through print books and online. Books and online material are developed by in-house experts.

Various Positions in Electronics/ Electrical/ Communication Industries in the area of Nano Scale Fabrication, Micro/Nano Electromechanical Systems (in Engineering/ Management domains).

- Service Engineer (Microscopy)
- Research Scientist (Materials Photovoltaic's)
- Atom Probe Engineer
- Internal Sales Engineer
- Application and Business Support Engineer
- Research Assistant/Associate
- Solar Energy Competitive Intelligence Leader
- Development Engineer (Wafer Fabrication)
- Senior Wafer Fabrication Process Engineer (Etching)
- Senior Wafer Fabrication Process Engineer

(Photolithography)

- Senior Research Engineer (Packaging Reliability)
- Senior Research Engineer (Circuit designer)
- Senior Research Engineer/Officer (Millimeter Wave and Modeling)
- Senior Research Engineer (MEMS Sensor Design)
- Senior Research Engineer(Analog & Mixed-Signal Circuit & System Design)
- Senior Research Engineer (MEMS & Advanced Package Reliability Engineering)
- Senior Research Engineer (Digital Integrated Circuits & Systems)
- Senior Research Engineer (Neuroprobe)
- Senior Research Engineer (Wafer Level Packaging for MEMS device)
- Senior Research Engineer (MEMS)
- MEMS Process R&D Manager
- Defect Metrology Engineer
- Product Engineer (LED Chips)
- Senior Epi Process Engineer
- Research Scientist (Wafer Fab)
- Manufacturing Engineer (MEMS Pressure Sensors)
- Engineer (Electronics Design)

- Generator Manufacturing Engineer
- Engineering Services Engineer (Control)
- Senior Scientist (Micro-Robotic Munitions)
- Test Engineering Manager
- Merchandising Execution Manager
- Engineer Systems Staff
- Lead Electronics Engineer
- Engineering Manager
- Sr Staff Test Engineer
- Account Clinical Director
- PGS GT Controls Senior Services Training Instructor
- Senior Scientist and Project Manager
- Senior Thermo Mechanical Engineer
- Market and Technology Development Manager
- Americas Thermal Manager - Global Field Operations
- Senior Configuration Manager
- Equipment-Facility Integration Engineer
- Solar Energy Competitive Intelligence Leader
- Senior Engineer (Testing & Power Grid Compliance)
- Lead Requisition Manager

Major Industries in Electronics Using Nanotechnology in their Products

- Samsung®
- AMD®
- a123systems
- Starkey, Inc.
- Multiple Manufacturers
- IBM®
- Apple®, Inc.
- Intel®
- Eikos® Inc.
- IOGEAR®, Inc.
- Lenovo
- LG® Electronics
- Asahi® Glass Co., Ltd.
- NovaCentrix, Corp
- Motorola®
- NanoFilm® Ltd.
- NanoHorizons®
- Nikon
- ABC Nanotech Co

- Nantero®, Inc
- Eastman Kodak® Company
- DuPont®
- Pioneer® Company
- Planet82™
- RiT Display Corporation
- Sanyo ®
- Sony® Corporation
- Ecology Coatings
- Panasonic® Inc.
- Universal Display Corporation®
- G7 Productivity Systems
- Microsoft®
- GE
- Pacific Biosciences, Inc.
- Pfizer
- Freeslate, Inc.
- Milliken & Company
- Air Force Materiel Command
- Freescale Semiconductor Inc,
- FEI Company

- Amkor Technology
- Hill-Rom, Inc.
- Lindeus
- Cree, Inc.
- Salimetrics LLC
- Solexant Corp.

Program Duration

The program duration is six months. However, the candidates have maximum period of nine months to complete the program. (It is inclusive of a grace period of three months against a re-registration fee of Rs. 2000 / US$ 75).

Eligibility

- Graduation/ Post-graduation/ PhD in Electronics/Electrical/Electronics & Communication
- Those who are pursuing Graduation can also join.
- Experienced professionals, academicians and researchers too are advised to join this program.

Fee Structure and Payment Norms

The program fee should be sent along with duly completed application form. The fee should be paid through a Demand Draft/ at par cheque, issued in favor of "**Nano Science and Technology Consortium" payable at "Delhi/ New Delhi".**

Fee Details:

Fee Details	Indian Students	Overseas Students
Program Fee*	Rs. 10,000=00	US$ 600 =00
Registration fee	Rs. 300=00	US$ 50=00
Total Fee	**Rs. 10,300=00**	**US$ 650=00**

Fee Includes "Books, Cds, LMS, Certification and Examination Fee".

* Fee inclusive of 10.3% Service Tax

Scholarships (Fee waiver)

1. Women Candidates -10% fee waiver
2. Group Scholarships -(a) three and above - 20% (b) five and above - 30% (c) ten and above - 40% (Single DD payment)
3. Academic Scholarships - Based on marks in last board/university exam passed, as given below.

Scholarship	Eligibility
10% fee waiver	60% - 70% marks in last board/univ. certification
15% fee waiver	71% - 80% marks in last board/univ. certification
20% fee waiver	81% - 90% marks in last board/univ. certification
25% fee waiver	More than 90% marks in last board/univ. certification

(Check scholarship conditions on www.nstc.in/programs)

Admission Procedure

i. Download the application form from http://www.nstc.in/programs and fill it properly.

ii. Make a DD/Cheque of required fee in favor of "**Nano Science and Technology Consortium"** payable at "Delhi/ New Delhi".

iii. Send the completed application form along with DD/Cheque and necessary documents* to:

Nano Science and Technology Consortium
A-105, Third Floor, Sector-63, Noida-201301, U.P, India
Contacts: +91-120-4781216/217, +91-9818206463

***Documents Required**

Highest degree certificate and mark sheet will be required for this program.

Certification

The participant is awarded the certificate and statement of marks after the completion of the program. All the participants are instructed to complete the program in the specified time of 3 months. Failing to meet this timeline requires a re-registration as per the norms specified on NSTC website

Policy Regarding Change in Registration Information

Any change in information provided to NSTC at the time of registration e.g. address or any other information will only be considered through written communication by post. No other mode of communication will be accepted.

Note

NSTC reserves the right to change the commencement/ conclusion dates of the program, with or without notice to the participants. NSTC strives to make the kit (study material) available to the participants in time, however, in the exceptional events of any delay from NSTC's side (not the delay on account of postal/ courier agencies), in providing the study material, the participant will be compensated with an extended timeline accordingly.

The Director NSTC is the final authority in all matters pertaining to this program.

Nano Science and Technology Consortium
A-105, 3rd Floor, Sector-63, Noida, UP,
INDIA 201 301
Mob. +91 9818206463, 0120-4781216/217
(Program Co-ordinator)

APPLICATION FORM

Nanoelectronics & Its Industrial Applications

A Distance Participation Program

with e- learning management system

Form No: .....

Affix your latest passport size photograph duly signed by you

(for office use only)

Enrolment No. | | | | | | | | | | |

1.Name (Mr./Ms.) _____ _____ _____
First Middle Last

2.Father's /Husband's Name _____

3.Postal Address (Capital Letters Only) _____

_____

City: _____ Pin Code | | | | | | |

State _____ Email: _____

Phone No. with STD Code _____ Date of Birth | | | | | | | | |
DD MM YYYY

Mobile No: _____

4.Academic Qualification:

Examination	Board/University	Year of Passing	% Marks
Graduation			
Post Graduation			
Any other			

5. Experience:

Present company (Name & Address)	Designation	Total Experience	Present Responsibility

6. (a) **Nationality**: _____(b) **Country of Residence**: _____

7. General information (P) mark only relevant column

Sex Male ☐ Female ☐

8. Crossed Demand Draft/Cheque No._____date_____

Drawn on _____ for Rs./ $ _____

(Bank draft must be drawn in favour of **"Nano Science and Technology Consortium"**. Payable at Delhi or New Delhi . Candidates are advised to write their name and address at the back of demand draft/ Cheque)

9. Scholarship (tick any one) Applicants must ensure that they have read scholarship terms & conditions given online at http://www. nstc.in before sending the application form and fee.

☐ Female candidate

☐ Academic Scholarship

☐ Group Discount (Minimum 3 applicants with single DD are eligible)

Please attach relevant documents for support.

11. Documents to be attached with application form:

i) Total Program Fee draft at the time of submitting application form

ii) Photocopies of certificate & marksheet of the latest Degree / Diploma, Documents in support of scholarship

iii) Passport size photograph

Note: NSTC accepts payable at par cheques only, other cheques are not acceptable.

Important Information

The program in which you are seeking participation, is NSTC's independent knowledge enhancement training program. The program neither promises any job guarantee nor provides any specific eligibility to pursue higher studies. In case of any dispute, it would have to be resolved through arbitration, under Arbitration and Conciliation Act 1996, by the sole arbitrator appointed by the NSTC, Noida. The jurisdiction of the same will be the Court of the District Gautam Buddha Nagar, Noida, India only.

Declaration by the Applicant

I hereby declare that I have read and understood the details of the program for which I seek admission. I have read scholarship & program terms & conditions given online and agree to the same. I have provided the necessary information in this regard. In the event that any information is found incorrect or misleading, my candidature shall be liable to cancellation by NSTC at any time and I shall not be entitled to refund of any fee paid by me to NSTC. I fully understand and agree that fee once paid is not refundable in any circumstances and is also not transferable.

Date:

Place: **Signature of Candidate**

Over 2,000 participants have already completed NSTC's Nanotechnology programs

NSTC's Program Participant Affiliations

- Accenture
- AIIMS
- Alagappa University
- Aligarh Muslim University
- Amrita Institute of Medical Sciences
- Anna University
- Apollo Hospital
- Ashok Leyland
- BARC
- Bharat Earth Movers Ltd.
- Bharat Electronics
- BHEL
- Biocon Ltd.
- BSNL
- Central Forensic Science Laboratory
- Cognizant Technologies
- Covansys
- Deloitte Consulting
- Department of Atomic Energy
- Dr. Reddys Lab
- DRDO
- Excel Hitech India Enterprises
- Grasim Industries Ltd.
- HCL Technologies Ltd.
- Hewlett Packard
- Hindustan Lever
- Hindustan Petroleum
- Honeywell Technology Solutions
- IIT Delhi
- IIT Guwahati
- Indian Agriculture Research Institute
- Indian Air Force
- Indian Army
- Indian Institute of Science
- Indian Navy
- Indian Oil Corporation Ltd.
- Infosys Technologies Ltd.
- ISRO
- Johnson & Johnson
- Larsen & Toubro
- Mahindra & Mahindra Ltd.
- Manipal Institute of Technology
- MRF Ltd
- NALCO Ltd.
- National Aerospace Laboratories
- National Metallurgical Laboratory
- National Physical Laboratory
- ONGC Ltd.
- Pfizer Ltd.
- Polaris Software Labs Ltd.
- Reliance Energy Ltd.
- Robert Bosch India
- SAIL
- SAP Labs
- Siemens
- SRL Ranbaxy Ltd.
- Sterlite
- Satyam Computers
- Syntel Inc. India Ltd.
- Tata Consultancy Services Ltd.
- TATA Research Development and Design Centre
- Tata Steel
- TB Research Centre, ICME
- Tech Mahindra Ltd.
- Unichem Labs Ltd.
- Vellore Institute of Technology
- Vikram Sarabhai Space Center
- Wipro Technologies

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