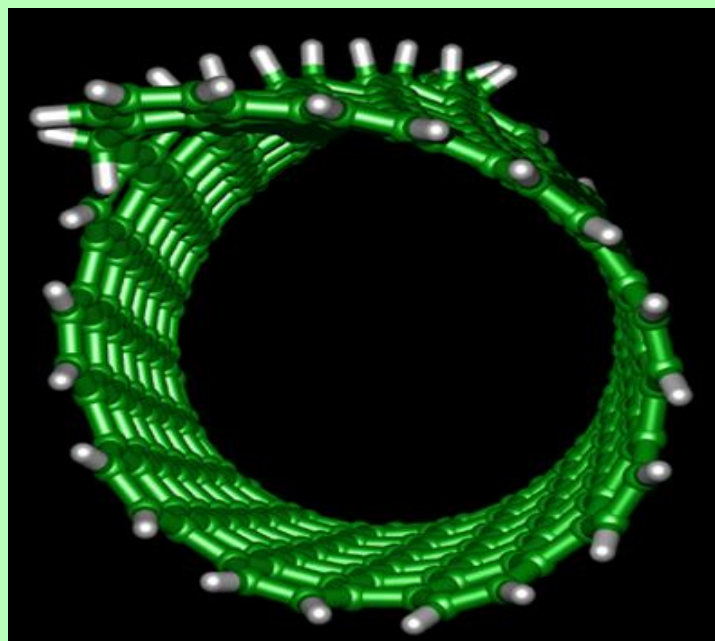
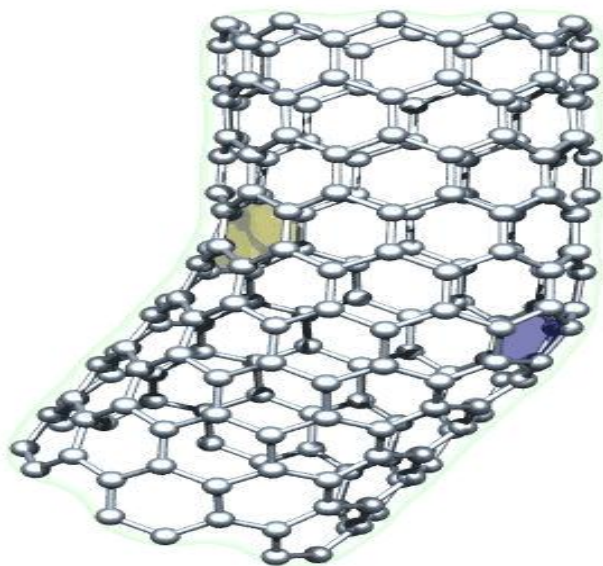




Information Bulletin

on

M. Tech. (Nanotechnology)



**Department of Physics,
Jamia Millia Islamia,
New Delhi**

Phone : 011-26988332, Fax : 011-26981753, E-Mail : mhusaincomtech@yahoo.com

M.Tech Nanotechnology

Nano-technology courses offer knowledge and training on the development and modification of devices with atomic precision where the dimension of particles is less than 100 nanometers. It is an interdisciplinary subject that integrates the study of Bio-informatics, Bio-technology, Physics, Chemistry as well as other disciplines. There is a huge demand for students who have done Nano-Technology Courses in a good number of industries and laboratories in India and abroad. The scope and application of nanotechnology is wide ranging and therefore many institutes are now introducing degree courses in this field at the graduate and post graduate level. Being an interdisciplinary subject, students with a degree in nanotechnology can find employment opportunities in a number of fields.

The areas where a nano-technologist can seek employment include agriculture, food and beverage, genetics, bio-technology, Space research, forensic science, environment industry and medicine.



Prof. M. Husain, Coordinator M. Tech

The most important feature in the field of Nanotechnology that has attracted worldwide researchers is the discovery of Carbon Nanotubes (CNTs). Carbon nanotubes (CNTs) are currently attractive materials for a diverse range of applications because of their extraordinary mechanical and electrical properties. Their application has already been demonstrated in field emission displays, nanoscale electronic devices, biosensors and hydrogen storage mediums. The proposed applications of CNTs are in micro-electronics/semiconductors, conducting composites, controlled drug delivery/release, artificial muscles, batteries, field effect transistors, nano-lithography, nanoelectronics, data storage, magnetic nanotube, molecular quantum wires, photovoltaic, electromagnetic shielding, cancer treatment, thermal protection, nanotube reinforced composites, AFM tip, super capacitor, catalysts support for fuel cells, polymer composites and sensors.

An essential point is that nanotechnology is not just about miniaturizing things. At the nanoscale different laws of physics come into play (quantum physics); the behaviour of surfaces starts to dominate the behaviour. Making materials of dimensions of nanoscale radically changes their properties.

[Relevance of this course in Jamia](#)

Keeping in view of the importance of Nanotechnology and the infrastructure available in Jamia, the Department of Physics has started an M. Tech course in Nanotechnology. This innovative Masters level course is designed so as to produce highly employable and knowledgeable post graduates in a fast developing area that is already making major economic contributions, impacting on products ranging from satellite TV through biomedical implants to sunscreens and even car dashboards.

The course would equip graduates with the skills to make a successful career in the new industries where reduced dimensionality plays a critical role in their products. It is designed as a series of lecture modules covering the technologies used to design, realize and analyze the nanoscale devices, materials and systems, coupled with the general and technology management. These are supported by project work, undertaken on both group and individual basis and conducted in close collaboration

with industry. Graduates emerge trained in a wide range of technical and management skills and with a sharp appreciation of the relevance of the subject to industrial needs.

The Department of Physics and Material Science Laboratory, Jamia Millia Islamia now has a thriving research and development activity in Microsystems and Nanotechnology, with very significant collaboration with DRDO, SSPL, LASTEC, NPL, DIT-MIT, IUAC, Delhi University (South Campus) and other CSIR laboratories.

This experience ensures that this M Tech course in Nanotechnology combines the necessary scientific rigour with industrial relevance.

List of Equipments and Infrastructure

The Department of Physics, JMI houses various equipments to be utilized by the M. Tech (Nano) students for their lab work and also by the research scholars in the Materials Science and Laser & Spectroscopy group. These include, the R.F. Sputtering unit, the Thermal Evaporation Coating unit, Spin Coating unit, I-V Characteristics (by Keithley systems), F.T.I.R, Flourimeter, Differential Scanning Calorimeter, ECR-Plasma Etching system, ECR-Chemical Vapour Deposition, Liquid Phase Chemical Vapour Deposition, Chemical Vapour Deposition, Scanning Electron Microscopy, Close-Cycle Helium Refrigerator, Nano-Voltmeter Current source (Keithley system), Gauss-meter, UV-Visible Spectrophotometer, LCZ meter, Set-up for measurement of Electrical Conductivity, Photo-conductivity, Dielectric Constant, Thermo-Electric Power, Micro-Raman Spectrometer, He-Ne Laser, CO₂ Laser, Vacuum furnace, Microprocessor Controlled furnace, Massive Library, Computational Facility with a 6-node Computer Cluster, Clean Room Facility, Online Journal Facility.

New Equipments to be Procured

Microwave Plasma Enhanced Chemical Vapour Deposition Unit, Scanning Probe Microscopy Unit and Field Emission Scanning Electron Microscope will be procured by the Department.

Course Objectives

The objective of the course is to give graduate students a thorough background in the skills necessary for a technically based career in the new high-tech industries, in which the manufacture of multifunctional devices with dimensions in the nanometre range is fundamental to wealth creation. Briefly:

- 1) Review the possibilities offered by the nano-technology revolution.
- 2) Introduce elemental quantum mechanical principles.
- 3) Introduce various nano-materials, principal fabrication approaches and nano-scale characterization tools.

Eligibility

- (i) M. Sc. in Physics/Chemistry (with Mathematics up to at least Bachelor's level) /Electronics Science/Material Science/Electronic Instrumentation, with not less than 55% marks in aggregate.

OR

- (ii) Bachelor's degree in Electrical/Mechanical/Electronics & Communication/ Computer Engg. Instrumentation/Computer Science or equivalent, with not less than 65 C.P.I. or 60% marks in the absolute system.

Course Structure

Duration: 2 Years (4 Semesters)

Semester I consists of Introduction to Solid State Physics (T1-01), Fundamentals of Nanoscience & Nanotechnology (T1-02), Foundation in Microsystems and NanoTechnology (T1-03) Thin Films Growth and Epitaxy (T1-04) and Laboratory (L-01). Semester II consists of Nanoscale Materials and Devices (T2-01), Nano-synthesis and Manufacturing (T2-02), Characterization of Nanomaterials (T2-03), Sensor Technology (T2-04) and Laboratory (L-02). Semester III consists of Carbon nanotubes (T3-01), Mathematical Modeling and Simulation of Nanostructure (T3-02), Nanodevices (T3-03), Nano-circuits Design (T3-04) and Laboratory (L-03).

In the fourth semester, all students have to do a substantial research type project during their study period. Projects are generally based in one of the Nanoscience/technology research groups and involve a structured experimental investigation of a research or development nature.

Scopes of M.Tech. students in India and Abroad

There are very good career prospects for students who have successfully completed their M.Tech in Nanotechnology from a reputed institute in India. Some of the industries in India that employ candidates with a nanotechnology degree include Health Industry research and consulting-pharmaceutical; agriculture; environment industries; academic institutes; government and private research institutes and food and beverage industries among others.

A range of opportunities await candidates who are willing to go outside India where they can work in the segments of nano-polymer and nano-medicine and as integration engineers also. Lot of research opportunities exist in the areas of nano-device, nano-packaging, nano-wires, nano-tools, nano-biotechnology and nano-crystalline materials, nano-photonics and nano-porous materials to name a few. Nano-Science and Technology Institute, with its centers at Switzerland, Cambridge and Massachusetts offer a lot of job opportunities. ASME nano-technology institute in New York also provides job opportunities to deserving candidates.

Ph.D. Program in Nanotechnology

The Department of Physics is also running a Ph.D. program in Nanotechnology. **Two** students have already completed their Ph.D. in Nanotechnology and **five** research scholars are currently working. The following research papers have been published in International Peer-Reviewed Journals.

1. Effect of catalyst-deposition methods on the alignment of carbon nanotubes grown by LPCVD
Javid Ali, Avshish Kumar, Samina Husain and M. Husain
Nanoscience & Nanotechnology Letters (In Press)
2. Highly emissive and low refractive index layers from doped silica nanospheres for solar cell applications
D. Haranath, Namita Gandhi, Sonal Sahai, M. Husain, Virendra Shanker
Chemical Physics Letters 496 (2010) 100-103
3. Facile synthesis and step by step enhancement of blue photoluminescence from Ag-doped ZnS quantum dots
Sonal Sahai, Mushahid Husain, Virendra Shanker, Nahar Singh, D. Haranath
Journal of Colloid and Interface Science (In Press)

4. Variable Range Hopping in Carbon Nanotubes
Zishan H. Khan, Samina Husain and M. Husain
Current Nanoscience, 2010, 6, 626-641
5. Characterization and field emission studies of uniformly distributed multi-walled carbon nanotubes (MWCNTs) film grown by low-pressure chemical vapour deposition (LPCVD)
Javid Ali, Avshish Kumar, Samina Husain, Monika Kumari, Harsh, and M. Husain,
Current Nanoscience, 2010, (In Press)
6. Room temperature growth of wafer-scale silicon nanowire arrays and their Raman characteristics
Dinesh Kumar, Sanjay K. Srivastava, P. K. Singh, K. N. Sood, V. N. Singh, Nita Dilawar, M. Husain
J Nanopart. Res., 12, 2010, 2267-2276
7. Electrical and optical properties of thin film of a-Se₇₀Te₃₀ nanorods,
Zishan Husain Khan, M. Husain,
Journal of Alloys and Compounds, vol. 486, 2009, Pages 774-779.
8. Optical properties of selenium-tellurium nanostructured thin film grown by thermal evaporation,
Karunapati Tripathi, Adam A. Bahishti, M. A. Majeed Khan, M. Husain, M. Zulfequar,
Physica B, Vol. 404, 2009, Pages 2134-2137
9. J-E characteristics of Ni-catalyzed multiwalled carbon nanotubes
Zishan H. Khan, Sami Habib, Numan Salah, Shamshad A. Khan, Samina Khan and M. Husain
Int. J. Nano-Biomaterials, Volume 2, 2009, Pages: 226-233.
10. Electrical Transport via variable range hopping in an individual multi-wall carbon nanotube;
Zishan Husain Khan, M Husain, T P Perng, Numan Salah and Sami Habib
J. Phys: Condens. Matter, 20, 2008, 475207 (7 pp)
11. Variable-range hopping in Fe₇₀Pt₃₀ catalyzed multi-walled carbon nanotubes
Monika Aggarwal, Samina Khan, M. Husain, T. C. Ming, M. Y. Tsai, T. P. Perng and Zishan Husain Khan
European Physical Journal B, The: Condensed Matter, 60 (3), 2007, p. 319-324.
12. Field Emission of Fe₇₀Pt₃₀ catalyzed Multi-walled Carbon Nanotubes
Samina Khan, K. N. Tripathi, Monika Aggarwal, K. P. Tripathi, Zishan H. Khan, M Husain
Journal of Experimental Nanoscience, Vol. 2, No. 3, Sept. 2007, 215-228.
13. Synthesis of carbon nanotubes using Ni₉₅Ti₅ nanocrystalline film as catalyst
Samina Khan, Zishan H. Khan, K. N. Tripathi and M. Husain
Journal of Nanoscience & Nanotechnology, Vol. 7, 2007 1-5.
14. Electrical conduction mechanism in Fe₇₀Pd₃₀ catalyzed multi-wall carbon nanotubes.
Monika Aggarwal, M Husain, Samina Khan. And Zishan H Khan

Journal of Nanoparticle Research, 9 (6), 1047-55 (2006).

15. Characterization of Carbon Nano Tube grown on Fe₇₀Pd₃₀ films
Zishan H. Khan, S. S. Islam, S. C. Kung, T. P. Perng, Samina Khan, K.N Tripathi,
Monika Agarwal, M. Zulfequar and M. Husain
Physica B 373(2) (2006) 317.
16. Coarsening of nano sized carbide particles in 2.25Cr-1Mo power plant steel after
extended service
V. Jayan, M.Y. Khan, M. Husain
Materials Letters 58(2004) 2569-2573.

Projects undertaken at the Department

A major research project on Growth and Characterization of Multi-Wall Carbon Nanotubes sponsored by D.R.D.O., is undertaken by the Department. Another Mega Project of Rs. 3.81 crore sponsored by the Department of Information Technology has just started in the Department. This project is on the Growth of Single Wall-Carbon Nanotubes and their Applications in Semiconducting Devices.

Placements

The first and Second batch of 15 students each successfully completed the course and all the students are placed as either Scientist/Engineers in esteemed research institutions of India like National Physical Laboratory, Indian Institute of Astrophysics, Decore Science and Technology, Gandhinagar, IIT Delhi, IIT Kharagpur, King Abdul Aziz University, Jeddah *or* as Faculty Members in various Engineering Colleges, like Amity College of Engineering, Al-Falah Institute of Technology, Galgotia Engineering College etc.

Faculty Members

Prof. M. Husain (Course Coordinator)
Prof. M.A. Wahab
Dr. Harsh (Scientist G and formally Associate Director SSPL, New Delhi)
Prof. M. Zulfequar
Prof. M. Shareef (Department of Chemistry, JMI)
Dr. Saeed Uddin
Dr. Azher Majid Siddiqui
Dr. M. Shahid Khan
Dr. Aurangzeb Khurram Hafiz
Prof. M.R. Khan (Deptt. of Elect. & Comm., F/O Engineering, JMI)
Prof. Ayub Khan (Department of Mathematics, University of Delhi)

Advisors

Dr. Krishan Lal, Chairman CODATA, France, (Ex-Director, NPL)
Dr. Vikram Kumar (Ex-Director, NPL)
Prof. H. R. Khan (University of Applied Sciences, Aallen, Germany)
Prof. Z.H. Khan (Director, CIT, JMI)
Prof. S.S. Islam (Faculty of Engineering, JMI)
Prof. Alim H. Naqvi (*Coordinator Nanotechnology Program, AMU, Aligarh*).

Equipments Facility in Nanotechnology Lab



Scanning Electron Microscopy Set up



RF Sputtering Unit



Low Pressure CVD Unit



I-V Measurement Unit



Low Temperature Coating Unit



Spin Coating Unit



Dielectric Constant Measurement Set up



Fluorescence Spectrophotometer



Thermal Evaporation System



Close-Cycle Helium Refrigerator



DC Sputtering Unit



X-Ray Diffraction Set up



Micro Raman Set up (Applied Science F/O Engg)



ECR Plasma Etching System



Differential Scanning Calorimeter



FTIR Set up



UV-Visible Spectrophotometer



Muffle Furnace