

Program Outcome, Program Specific Outcome and Course specific Outcomes of Masters of Science and Master of Philosophy in Nanosciences and Nanotechnology

General Program Outcomes:

In order to initiate awareness of research ongoing in the field of Nanosciences and nanotechnology, NCNNUM has introduced post-graduation course work entitled “Masters of Science in Nanosciences and Nanotechnology” and “M. Phil. in Nanosciences and Nanotechnology”. The course work designed not only gives awareness to young researcher towards the subject/technology but also provides flexibility to work in interdisciplinary manner to provide solutions for society problems in more scientific way. Understanding growing demand and the need to literate and motivate young generation towards the field of Nanosciences and Nanotechnology (The field has already reduced the gap in between scientific research and technological breakthroughs in various area including medical, space, military, communication technology etc.): The National Centre for Nanosciences and Nanotechnology, University of Mumbai (NCNNUM) conducts two years full time post graduate course work (i.e. M.Sc.) in Nanoscience and Nanotechnology for the academic year 2016 onwards.

- Nanosciences and Nanotechnology being an interdisciplinary subject offers knowledge, understanding and output that is integrated and Interdisciplinary in nature.
- Quality, inclusive and focused education
 - To develop trained manpower in the field of Nano Science and Nanotechnology with specific emphasis for exploitation of Nano Science and Nanotechnology looking at the demand/need of changing trends of modern Industries.
 - Amalgamate traditional research for Nano Science with advanced cutting-edge technologies for product development and manufacturing such as NEMS, MEMs, nano drugs, lab on chip concepts, etc.
 - Introduce the powerful tools of Nano Science and Nanotechnology for R&D with a rigorous attention to device fabrication.
 - Exposure to National & International research in the field of Nano Science and Nanotechnology.

Course Specific Outcomes

<p>The CBSGS pattern has been introduced in 2016 and continues till the date</p>		
<p>M.Sc. (CBCS) (Nanosciences and Nanotechnology)</p>	<p>Understanding growing demand and the need to literate and motivate young generation towards the field of Nanosciences and Nanotechnology (The field has already reduced the gap in between scientific research and technological breakthroughs in various area including medical, space, military, communication technology etc.): The National Centre for Nanosciences and Nanotechnology, University of Mumbai (NCNNUM) conducts two years full time post graduate course work (i.e. M.Sc.) in Nanoscience and Nanotechnology for the academic year 2016 onwards. The proposed course work will offer an opportunity to students to combine solid scientific knowledge with extensive skills developed through hands-on research experience in cutting-edge technologies and state-of-the-art facilities developed at the centre. This rigorous degree program designed pulls many areas of the natural sciences such as chemicals, materials, and structures that occur at the nano level (i.e., smaller than 100 nanometers). Students have freedom to choose courses and conduct research on topics related to nanosciences and nanotechnology in collaboration with research institutes as well as industries.</p>	
<p>Semester I</p>		
<p>Name of the Course</p>	<p>Course Code</p>	<p>Activities with direct bearing on Employability/ Entrepreneurship/ Skill development</p>
<p>CNN-101</p>	<p>Essential Physics</p>	<p>Core competency development in basics of physical sciences viz. atoms and molecules, the elementary principals, mathematical principles, electronics, etc.</p>

CNN-102	Essential Chemistry	Core competency development in basics of chemical sciences <i>viz.</i> Chemical Kinetics, thermodynamics, surface chemistry and colloids, chemical bonding, etc.
CNN-103	Essential Mathematics	Core competency development in mathematical science. Devising or using depictions of mathematical objects or relationships: equations, formulae, graphs, tables, diagrams, textual descriptions.
CNN-104	Essential Biology	Core competency development in biophysical techniques, cell biology, cell signalling, immune system and bio-sensor.
CNN-111	Phys. Lab I	Hands on experience on two and four probe conductivity measurement; hall effect, mobility and carrier concentration measurement for semiconductor.
CNN-112	Phys. Lab II	Hands on experience on thin film deposition and its characterization.
CNN-113	Chemistry. Lab I	Hands on experience and developments/demonstration of skills in qualitative and quantitative analysis.
CNN-114	Chemistry. Lab II	Hands on experience on synthesis of nanomaterials and its physical and thermal parameter study.
Semester II		
CNN-201	Solid State Physics	Core competency development in crystal structure, phonons, semiconductors, Plasmon's-polaritons and polarons.

CNN-202	Fundamentals of nano materials	Orientation and introduction towards Nanotechnology skill sets in miniaturization, synthesis, properties and applications of nanomaterials.
CNN-203	Interaction of matter with radiations	Foundation of spectroscopy skill in quantum mechanics, atoms and molecules.
CNN-204	Experimental Methods	Development of core competency in experimental techniques such as vacuum, ultra-high vacuum, thermal evaporation, chemical and electrochemical methods.
CNN-211	Synthesis and Characterization of nanomaterials	Hands on experience in synthesis and characterization of nanomaterials using sophisticated instruments.
CNN-212	Synthesis and Characterization of Biomolecules and Biomaterials	Hands on experience in synthesis and characterization of biomolecules and biomaterials
CNN-213	Vacuum systems and techniques	Hands on experience on vacuum pumps, vacuum gauge, thermal evaporation system, pulse laser deposition system, DC sputtering system, etc.
CNN-214	Laboratory IV	Hands on experience on spectroscopy and electrochemistry.

Semester III

	Micro-Nanofabrication	Core competency development in micro-nanofabrication viz. Nano Fabrication by photons, Charged Beam, Scanning Probes and Self Assembly; MEMS - NEMS fabrication; CNC milling and micro-machines; 3D printing, etc.	
	Nano-SHE (Safety Health and Environment)	Core competency development in Functional principles of Bionanotechnology therapies, Nanomachines, Nanobarcodes and Nanobiosensors, Nanopharmaceuticals, Nanomedicine: Applications, Nanoparticle in Aquatic and Terrestrial Environment, Nanoparticles as pollutants, Nanoparticle Safety: United States perspective, Human Effects of Nanoparticle Exposure, etc.	
	Elective course	Nanodevices (Chemistry, Physics, Biology approaches)	Core competency in devices viz. Basic Concepts, device concept, Sensor and detector Materials, Humidity and moisture sensors, Temperature Sensors, Light Detectors, Radiation Detectors, etc.
		Advance Instrumentation methods	Detail exposure to state of art instrumentation facility such as Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunnelling Microscopy (STM), X-Ray Diffraction (XRD), Spectrochemical Methods, etc.
		Nanotechnology in Food and Agriculture Industry	Core competency in food and agriculture science such as Intermolecular interactions and supramolecular structures, Nanoparticles in agricultural and food diagnostics, Nanotechnology in food production, Nanotechnology in food packaging, etc.
	Optional Courses	Electrochemical Power sources and Nanotechnology	Detail exposure to application of electrochemistry in power sources and nanotechnology viz. batteries, supercapacitor, fuel cells, etc.
		Industrial nanotechnology	Development of nanotechnology skills required for industrial applications.
		Nanotechnology in Defense and Space	Core competency in applications of nanotechnology in defence and space such as Nanobio: Smart nanobio materials/sensors for chemical/bio-warfare.

	Numerical methods and recipes	Skill development in computational methods.
	Research methodology	Imbibe research aptitude and good professional practices.
	Short Term Project	Collection, interpretation and presentation of research data for identification of research problem.
Semester IV		
	Project	Exposure to real world and open ended research problems.
There have been choices provided in the syllabus which can be offered by the students depending on their own interest.		