Title of the Course: Introduction to Nanoscience and Technology

Code: SC431

Credit structure: 3-0-0-3

Course Description
This course would be focused on current widespread interest in Nanoscale science, technology, materials, manufacturing techniques, nanodevices and nanoproducts. Nanoscale science and technology are, in general, the study of structures that have the size of at least one dimension less than of 100 nm. In this scale new properties and behaviour come up which are not normally observed in our macro-world. This happens because particles which are smaller than the characteristic lengths associated with particular phenomena often display new chemistry and physics, leading to new behaviour which depends on size. This course would investigate how physical, chemical, mechanical, biological properties change drastically when particles become smaller than a critical size. We would try to understand how bottom-up approach generates nanocrystals, how on nanoscale some particles initiate a process of self-assembly. Carbon nanostructure would be covered in detail for its huge potential of application. Few salient methods/tools for manufacturing at nanoscale would be discussed. Single electron transistor would be covered and discussed during the course.

Course Pre-requisite
None

Course Content
Fundamental Science of Nanotechnology
Electrons, Atoms, Molecules
Molecular binding
Biosystems

Introduction of Nanoworld
Does Size Matter?
Synthesis of Nanoparticles by Chemical and Physical Methods
Control and Stability (Size, Shape, Morphology, Composition)
Surface phenomena – Forces between particles and surfaces

Viewing at nano level
History of scopy/viewing
Scanning Probe Microscopy
Transmission Electron Microscopy and Scanning Electron Microscopy
Other methods
Fabrication at nano level
Introduction of CMOS Technology
Nanolithography
Self Assembly

Applications of Nanotechnology
Carbon Nanostructures
Quantum Dots
Single Electron Transistor
Other commercial products

Evaluation
2 Insem exams
1 Final sem exam

Attendance Policy
1. 80% attendance is compulsory.

2. Failing this, your grade will be pulled down according to the following metric:

<table>
<thead>
<tr>
<th>Attendance</th>
<th>Penalty</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>61-79%</td>
<td>1 level down</td>
<td>if getting a BB grade, you will be awarded a BC</td>
</tr>
<tr>
<td>45-60%</td>
<td>2 levels down</td>
<td>if getting a BC grade, you will be awarded a CD</td>
</tr>
<tr>
<td>&lt; 45%</td>
<td>cannot write end sem exam</td>
<td>likely to get F or DE grade</td>
</tr>
</tbody>
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3. Attendance will be taken in all classes of the present students only. Remaining students will be considered absent from the class of that day (date).

4. Leave during semester is governed as per the Institute’s policy. PI refer to
\daiict\Academic\Student Leave Policy_WEF_Autumn_2012.pdf

Recommended Books
1. Understanding Nanotechnology: From the Editors of Scientific American; Warner Books
2. Introduction to Nanotechnology by Charles P. Poole Jr. & Frank J. Owens; Wiley
3. Stories of the Invisible: A Guided Tour of Molecules by Philip Ball; Oxford Univ Press
5. Designing the Molecular World by Philip Ball; Princeton Science Library
6. The Chemistry of Nanostructured Materials by Peidong Young (editor); World Scientific
   Made to Measure by Philip Ball; Princeton Univ Press
7. Physical Properties of Carbon Nanotubes by R. Saito, G. Dresslhaus & M. S. Dresslhaus; Imperial College Press
8. Nanocosm by W. I. Atkinson; American Management Committee
9. Nanotechnology: A Gentle Introduction to the Next Big Idea by Mark Ratner & Daniel Ratner; Pearson Education
10. The Self-Made Tapestry by Philip Ball; Oxford Univ Press
11. Structure and Bonding by Jack Barrett; Wiley
12. Quantum Dot Heterostructure by Bimberg, Grundmann & Ledentsov; Wiley