ATENEO DE MANILA UNIVERSITY
COURSE SYLLABUS

COURSE NUMBER: MSE 188.2  
INSTRUCTOR: Dr. Eduardo C. Cuansing
COURSE TITLE: Introduction to Nanotechnology  
OFFICE: F-305
CREDITS: 3 units  
CONSULTATION HOURS: TBA
SEMESTER: 2nd  
EMAIL ADDRESS: ecuansing@ateneo.edu
COURSE SCHEDULE: MWF, 1130-1230  
CLASSROOM: F-114
PRE-REQUISITES: MSE 102 or equivalent or consent of the instructor

COURSE DESCRIPTION:
This is a 3-unit introductory lecture course on the nature of nanotechnology and its applications for undergraduate students majoring in chemistry, physics, or engineering. Because of the varied background of the intended students and the interdisciplinary nature of the topics, a brief review of relevant concepts in quantum mechanics and statistical mechanics, including reaction kinetics and chemical equilibria, will take place during the early part of the course. Afterwards, topics to be discussed include the theoretical and conceptual framework of nanotechnology, the physics and chemistry of nanostructures, electron transport in nanostructures, molecular electronics, and nanobiology. During the course, a conscious effort will be made to relate the socio-economic impacts of nanotechnology to the Philippines and the global community.

COURSE OBJECTIVES:
At the end of the semester, students are expected to:
   a) Define and describe nanotechnology;
   b) Recognize and understand the unique features of nanostructures and nanotechnology;
   c) Understand the processes and techniques involved in creating and assembling nanostructures;
   d) Appreciate present and future developments in nanotechnology;
   e) Have a familiarization of various applications of nanotechnology;
   f) Develop an awareness of the global and local socio-economic impacts of nanotechnology.

TEXTBOOK:

REFERENCE:

COURSE OUTLINE:

<table>
<thead>
<tr>
<th>TIME</th>
<th>CHAPTER</th>
<th>TOPICS</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Chap. 1: What is nanoscience?</td>
<td>Nanometer-scale sizes, Feynman’s wish-list, Schrödinger’s cat, quantum effects and fluctuations in nanostructures</td>
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<tr>
<td>Week 2, 3</td>
<td>Chap. 2: Quantum mechanics</td>
<td>Uncertainty principle, wave functions, Pauli exclusion principle, Schrödinger equation, tunneling, hydrogen atom</td>
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<td>Week 4, 5</td>
<td>Chap. 3: Statistical mechanics and chemical kinetics</td>
<td>Entropy, partition function, free energy, fluctuations, chemical kinetics, nanothermodynamics</td>
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<td>Week 6</td>
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<td>LONG EXAM 1</td>
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<td>Week 6</td>
<td>Chap. 4: Microscopy and manipulation tools</td>
<td>Scanning tunneling microscope, atomic force microscope, tweezers, single-molecule experiments</td>
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<td>Week 7</td>
<td>Chap. 5: Making nanostructures: top down</td>
<td>Photolithography, thin films, molecular beam epitaxy, MEMS, NEMS, nanoscale junctions</td>
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Week 8 | Chap. 6: Making nanostructures: bottom up | Organic synthesis, self-assembly, nanowires, quantum dots, DNA nanotechnology
Week 9, 10 | Chap. 7: Electrons in nanostructures | Band structure, Fermi surfaces, Brillouin zones, Landauer resistance, resonant tunneling, Coulomb blockade
Week 11 | LONG EXAM 2 |
Week 11, 12 | Chap. 8: Molecular electronics | Hybridization, Hückel model, Marcus theory, hopping conductance, single-molecule electronics
Week 13 | Chap. 9: Nanostructured materials | Nano-electronics, superlattices, heterostructures, surfaces, nano-thermal devices, nanofluidic devices
Week 14 | LONG EXAM 3 |
Week 14 | Chap. 10: Nanobiology | Molecular biology, enzymes, bio-nanomachines, thermal ratchets, molecular motors, fluctuations
FINAL EXAM

NOTE: Each Long Exam is for two hours and will be held outside of the regular lecture class hours. Calculators are not needed during an exam.

GRADE CALCULATION:

3 Exams .............................................. 60 %
Problem Sets ........................................ 15 %
Final Exam ......................................... 25 %
TOTAL ............ 100 %

GRADING SYSTEM:

A  92 – 100
B+  86 – 91
B   77 – 85
C+  69 – 76
C   60 – 68
D   50 – 59
F    Below 50

SOME CLASS POLICIES:

1. Cheating is a serious offense. Anyone caught cheating will be dealt with according to the provisions of the student handbook. During exams, any form of communication between students, without prior notice from the teacher, is going to be considered as cheating. If you have questions or need anything, approach the teacher first.
2. Absence during exams and problem set submissions merits a zero. Late problem sets are accepted but with a 20% penalty per day and there is no distinction between an excused and an unexcused absence. For a missed exam, a makeup is given only when the absence is excused.
3. The maximum number of absences is 9 hours. Anybody coming in after the roll call will be marked absent though he/she will be allowed to stay in class and take notes.
4. Students are expected to maintain discipline and extend all due respect to their classmates, instructor, laboratory technicians, and any other person they may have to work with at all times.
5. Cellphones and other electronic gadgets must be turned off or silent during class hours. Cellphone operation during class hours is not allowed and will be considered cheating during exams.