University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td colspan="10">8101677: Course Name: Nano-Electronics and Nano-technology</td></tr>
<tr><td>Course type:</td><td colspan="10"><table>
<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">Credit:

3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td colspan="10">Graduate</td></tr>
<tr><td>Co-requisite(s):</td><td colspan="10">None.</td></tr>
<tr><td>Prerequisite(s):</td><td colspan="10">Electronic Physics(8101277)</td></tr>
<tr><td>Prerequisite by topic:</td><td colspan="10">Familiarity with quantum and solid state physics and semiconductor devices.</td></tr>
<tr><td>Textbook(s):</td><td colspan="10">[1] Introduction to Nanotechnology, Charles P. Poole, Frank J. Owens, Wiley, 2003.
[2] Carbon Nanotubes, S. Reich, C. Thomsen, J. Mauiltzsch, Wiley-VCH, 2003.
[3] Nanoscience, Nanotechnologies and Nanophysics, C. Dupas, P. Houdy, M. Lahmani, Springer, 2004.</td></tr>
<tr><td>Coordinator:</td><td colspan="10">S. Mohajerzadeh, Professor, School of ECE</td></tr>
<tr><td>Goals:</td><td colspan="10">Familiarity with physics and technological aspects of nano-structures. A great attention is paid to carbon nanotubes and grapheme layers and nano-ribbons. Some technological features of modern nano-electronic circuits are discussed. Issues such as lithography and bottom-up or top-down processes are introduced. Subject to time, self-assembled structures are presented. A quick introduction to molecular electronic devices is given. Quantum dots and nanowires are discussed.</td></tr>
<tr><td>Outcome:</td><td colspan="10">Upon successful completion of the course, students will have:
1. knowledge about complex fabrication processes at nanoscale,
2. knowledge of nano-electronic devices
3. knowledge of physics behind various nano-scale devices,
4. knowledge of tight-binding theory and application to CNTs/GNR,
5. Knowledge about molecular electronic and Huckel approximation.</td></tr>
<tr><td>Topics:</td><td colspan="10">1- Semiconductor fabrication processes: A survey on IC-fabrication steps.
2- Introduction to Nano-fabrication processes, top-down and bottom-</td></tr>
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	up processes **3- Tight-binding theory,** An important background to model carbon nanotubes and graphene structures. **4- Characterization tools,** Atomic force microscopy, Electron microscopy, Tunneling microscopy, optical microscopy **5- Quantum dots/nanowires,** physics of quantum dot operation, resonance tunneling, transport, Quantum conductance, etc. **6- Molecular Electronic** Introduction to Huckel molecular Orbitals, HOMO-LUMO gaps, molecular switches and devices **7- Ballistic Transistors,** Transport in ballistic devices, Natori's theory, velocity saturation **8- Self assembled structures,** subject to time
Computer usage:	Simulation of nanolithography, pattern engineering, E-K diagram
Assignments:	Two or three assignments are given to students to become familiar with topics.
Projects:	One presentation is optional (subject to time)
Grading:	Assignments: 10 % Quiz: 0% Midterm exams: 30 % Final exam: 60 %
Further readings:	Ashcraft and Mermin, Solid State Physics,
Prepared by:	S. Mohajerzadeh, Professor, School of ECE
Date:	2017

*EE: Electrical Engineering CE: Computer Engineering IT: Information Technology