Solid State Electronics and Photonics
Electrical and Computer Engineering
The Ohio State University

An Overview for Prospective Students

http://www.ece.osu.edu/ssep
Areas of ECE Concentration

- Circuits
- Communications and Signal Processing
- Computer Engineering
- Controls
- Electromagnetics
- Power Systems
- Solid State Electronics and Photonics
Areas of ECE Concentration

• Controls
• Communications and Signal Processing
• Computer Engineering
• Electromagnetics
• Circuits
• Solid State Electronics and Photonics
• Power Systems

“The Food Chain”
The terms “even” or “odd” refer to the year in which the quarter occurs. For example, autumn ’02 is even, winter ’01 is odd, even though they are in the same academic year.
Solid State Electronics and Photonics

- Electronic Devices
- Optoelectronic Devices
  - Solar cells, LED’s, CD lasers, Fiber optics
- Nanoelectronics
- Plastic semiconductors
- Micro-machines
Computer Food Chain
Career Opportunities

- **Bachelor’s**
  - Manufacturing?
- **Master’s**
  - Development?
- **Ph.D.**
  - Fundamental Research?
Moore’s Law
A new technology every 2 years

<table>
<thead>
<tr>
<th>Process Name</th>
<th>P856</th>
<th>P858</th>
<th>Px60</th>
<th>P1262</th>
<th>P1264</th>
<th>P1266</th>
<th>P1268</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Production</td>
<td>1997</td>
<td>1999</td>
<td>2001</td>
<td>2003</td>
<td>2005</td>
<td>2007</td>
<td>2009</td>
</tr>
<tr>
<td>Lithography</td>
<td>.25µm</td>
<td>.18µm</td>
<td>.13µm</td>
<td>90nm</td>
<td>65nm</td>
<td>45nm</td>
<td>32nm</td>
</tr>
<tr>
<td>Gate Length</td>
<td>.20µm</td>
<td>.13µm</td>
<td>&lt;70nm</td>
<td>&lt;50nm</td>
<td>&lt;35nm</td>
<td>&lt;25nm</td>
<td>&lt;18nm</td>
</tr>
<tr>
<td>Wafer Size (mm)</td>
<td>200</td>
<td>200</td>
<td>200/300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
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</tbody>
</table>
Accelerated Scaling of Planar Transistors

- 130nm Node
- 70nm Length (Production in 2001)

- 90nm Node
- 50nm Length (Production in 2003)

- 65nm Node
- 30nm Prototype (Production in 2005)

- 45nm Node

- 32nm Node
- 20nm Prototype (Production in 2007)

- 15nm Node
- 15nm Prototype (Production in 2009)
Silicon devices are Nanotechnology

Transistor for 90nm process
Source: Intel

Influenza virus
Source: CDC

15nm Research Transistor
Transistor Gate Length Scaling

Transistor Gate Length is **Smallest** Feature on the Device
Our OSU ECE Program

- **Ranked #22 in the nation out of 126** ECE Programs nationwide by the National Research Council, the most comprehensive academic program review, every ~8-12 years!

- Highest in the State of Ohio.

- **Tier #1 Research University** – our faculty participate and drive leading edge research, not reading about it in a book.
# National Research Council Doctoral Program Study
## The Ohio State University – Engineering

<table>
<thead>
<tr>
<th>Department</th>
<th>Rank/Total</th>
<th>Effective</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>24/33</td>
<td>27.3%</td>
<td>2.84 (good)</td>
</tr>
<tr>
<td>Biomedical</td>
<td>26/38</td>
<td>31.6%</td>
<td>3.26 (strong)</td>
</tr>
<tr>
<td>Chemical</td>
<td>40/86</td>
<td>53.5%</td>
<td>2.73 (good)</td>
</tr>
<tr>
<td>Electrical</td>
<td>22/126</td>
<td>82.5%</td>
<td>3.53 (strong)</td>
</tr>
<tr>
<td>Mechanical</td>
<td>25/110</td>
<td>77.3%</td>
<td>3.32 (strong)</td>
</tr>
<tr>
<td>Material Science</td>
<td>21/65</td>
<td>67.7%</td>
<td>3.48 (strong)</td>
</tr>
</tbody>
</table>
## National Research Council Doctoral Program Study
### The Ohio State University – Sciences

<table>
<thead>
<tr>
<th>Department</th>
<th>Rank</th>
<th>Quality</th>
<th>Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>22/168 86.9%</td>
<td>3.87 (strong)</td>
<td>3.79 (extremely)</td>
</tr>
<tr>
<td>Computer Science</td>
<td>39/108 63.9%</td>
<td>2.92 (good)</td>
<td>2.94 (reasonable)</td>
</tr>
<tr>
<td>Math</td>
<td>29/139 79.1%</td>
<td>3.66 (strong)</td>
<td>3.13 (reasonable)</td>
</tr>
<tr>
<td>Physics</td>
<td>24/147 83.7%</td>
<td>3.75 (strong)</td>
<td>3.70 (extremely)</td>
</tr>
<tr>
<td>Astrophysics &amp; Astronomy</td>
<td>23/33 30.3%</td>
<td>2.91 (good)</td>
<td>2.76 (reasonable)</td>
</tr>
<tr>
<td>Biochemistry &amp; Molecular Biology</td>
<td>59/194 69.3%</td>
<td>3.16 (strong)</td>
<td>3.22 (reasonable)</td>
</tr>
</tbody>
</table>

*Note: The numbers in parentheses indicate the level of quality or effectiveness.*
**Big is Small**

- Breadth and Strength across Ohio State
  - *Students change majors 3-4 times, on average.*
- Feels Small Within ECE
  - *ECEs know each other*
  - *ECEs know their faculty*
- Interaction with Faculty
  - *Within each ECE discipline, close knit.*
Thanks for your time!

- Electrical and Computer Engineering is important.
  - *It has revolutionized the world we live in, and will continue to do so for the foreseeable future.*
- Electrical and Computer Engineers earn good money.
  - *ECE ranks at the top of engineering disciplines.*
- Electrical and Computer Engineering is fun!
  - *Challenging, exciting work.*