Course Description
MOSCAPs, Gated Diode, CMOS Bulk/SOI Transistors, Photodiodes, Carrier Transport/Storage, Scaling, Mobility, CCDs, CMOS, EEPROMs, SiGe, SiC, ISFETs, BJTs, Noise and Modeling.

Prior Course Number: 894, 8194.04
Transcript Abbreviation: Adv Semicond Dev
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 5530 (730) or 6531.
Exclusions: Not open to students with credit for 894 (Spring 12, Class number 26147) or 8194.04.
Cross-Listings:

Course Rationale: Train graduate students in advanced semiconductor topics.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Course Goals

| Students learn about quantum effects of device scaling on performance and reliability |
| Students learn modeling of MOS transistors, CCDs, EEPROMs and other devices |
| Students learn measurement techniques for device characterization |

Course Topics

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<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
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<th>IS</th>
<th>Sem</th>
<th>FE</th>
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<tbody>
<tr>
<td>Historical overview: MOSCAP, gated diode, high-K dielectrics, amphoteric traps</td>
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<td>Generation-recombination theory, equilibrium, non-equilibrium, steady-state and non-steady-state, conductance, surface recombination boundary conditions</td>
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<td>CCDs, carrier transport and operation, transfer efficiency, charge control model</td>
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<tr>
<td>CMOS transistors (bulk, SOI, mobility, transconductance, subthreshold operation, SPICE modeling, short-channel and narrow-width effects, surface and buried channel devices, propagation delay, ion-sensitive FETs (ISFETs), hot carrier injection</td>
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<td>Charge pumping, interface and dielectric traps</td>
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<tr>
<td>Physics of tunneling- floating gate and SONOS EEPROMs</td>
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<td>Theory of drift-field bipolar junction transistors (BJTs)</td>
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<td>SiGe FETs and SiC devices</td>
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<td>Advanced research topics (e.g. mobility, surface roughness, Coulomb scattering, noise)</td>
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### Grades

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<tr>
<th>Aspect</th>
<th>Percent</th>
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<tr>
<td>Homework</td>
<td>60%</td>
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<tr>
<td>Midterm Exam</td>
<td>20%</td>
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<td>Final exam</td>
<td>20%</td>
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### Representative Textbooks and Other Course Materials

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
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<tr>
<td>Course notes and selected papers from the literature</td>
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### ABET-EAC Criterion 3 Outcomes

<table>
<thead>
<tr>
<th>Course Contribution</th>
<th>College Outcome</th>
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<tbody>
<tr>
<td><strong>a</strong></td>
<td>An ability to apply knowledge of mathematics, science, and engineering.</td>
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<td><strong>b</strong></td>
<td>An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
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<td><strong>c</strong></td>
<td>An ability to design a system, component, or process to meet desired needs.</td>
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<td><strong>d</strong></td>
<td>An ability to function on multi-disciplinary teams.</td>
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<td><strong>e</strong></td>
<td>An ability to identify, formulate, and solve engineering problems.</td>
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<td><strong>f</strong></td>
<td>An understanding of professional and ethical responsibility.</td>
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<td><strong>g</strong></td>
<td>An ability to communicate effectively.</td>
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<td><strong>h</strong></td>
<td>The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
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<tr>
<td><strong>i</strong></td>
<td>A recognition of the need for, and an ability to engage in life-long learning.</td>
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<td><strong>j</strong></td>
<td>A knowledge of contemporary issues.</td>
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<tr>
<td><strong>k</strong></td>
<td>An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
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Prepared by: Betty Lise Anderson