# ECE 6531: Fundamentals of Semiconductor Devices

## Course Description

An overview of the physics, design, and engineering of semiconductor electronic and optoelectronic devices. Applications of silicon, compound semiconductor, and nanotechnology will be covered.

**Prior Course Number:** 831
**Transcript Abbreviation:** Fund 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 permission of instructor.
**Exclusions:** Not open to students with credit for 5531.
**Cross-Listings:**

**Course Rationale:** Existing course.

**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

## Programs

| Abbreviation | Description |
| --- | --- |
| CpE | Computer Engineering |
| EE | Electrical Engineering |

## Course Goals

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| --- |
| Learn advanced semiconductor device physics. |
| Learn to design semiconductor devices. |
| Learn performance limits of state-of-the-art semiconductor devices and approaches for overcoming them. |

## Course Topics

| Topic | Lec | Rec | Lab | Cli | IS | Sem | FE | Wor |
|---|---|---|---|---|---|---|---|---|
| Device applications of semiconductors | 1.0 | | | | | | | |
| Transport in heterojunctions | 3.0 | | | | | | | |
| Photodiodes and optoelectronic integrated circuits | 3.0 | | | | | | | |
| Solar cells - an introduction | 3.0 | | | | | | | |
| Light emitting diodes | 3.0 | | | | | | | |
| Laser diodes - an introduction | 1.0 | | | | | | | |
| Heterojunction FET - HEMT | 5.0 | | | | | | | |
| Long-channel MOSFET models | 1.0 | | | | | | | |
| Sub-micron MOSFET - threshold volt, sub-threshold current, scaling, hot carriers | 2.0 | | | | | | | |
| Bipolar junction transistors | 3.0 | | | | | | | |
| Heterojunction bipolar transistors | 3.0 | | | | | | | |
| Tunnel diodes, resonant tunneling diodes | 3.0 | | | | | | | |
| Wide-bandgap semiconductors - transport physics and optical properties | 3.0 | | | | | | | |
| High-frequency and high power wide-bandgap electronics | 3.0 | | | | | | | |
| Optical devices based on wide-bandgap semiconductors | 3.0 | | | | | | | |

## Representative Assignments

| Homework |
|---|

## Grades

| Aspect | Percent |
|---|---|
| Homework | 20% |
| Two mid-term examinations | 40% |
| Final examination | 40% |

## Representative Textbooks and Other Course Materials

| Title | Author |
|---|---|
| *Semiconductor Device Physics and Design* | Umesh Mishra and Jasprit Singh |

## ABET-EAC Criterion 3 Outcomes

| Course Contribution | | College Outcome |
|---|---|---|
| *** | a | An ability to apply knowledge of mathematics, science, and engineering. |
| | b | An ability to design and conduct experiments, as well as to analyze and interpret data. |
| ** | c | An ability to design a system, component, or process to meet desired needs. |
| | d | An ability to function on multi-disciplinary teams. |
| ** | e | An ability to identify, formulate, and solve engineering problems. |
| | f | An understanding of professional and ethical responsibility. |
| | g | An ability to communicate effectively. |

| Course Contribution | | College Outcome |
|---|---|---|
| | h | The broad education necessary to understand the impact of engineering solutions in a global and societal context. |
| ** | i | A recognition of the need for, and an ability to engage in life-long learning. |
| * | j | A knowledge of contemporary issues. |
| ** | k | An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

## Additional Notes or Comments

corrected prereq from 4530 to 5530. Updated prereq, exclusion, goals, and topics to university format.

Removed exclusion 10/9/12.

Renumbered from 5531 11/21/13

Make consistent with university tool 3/5/14 BLA

Remove "or grad standing in ..." from prerequisites and replace with "or permission of instructor."  3/5/15  GJV

**Prepared by:** George Valco