

ECE 5131: Lasers

Course Description

Atomic interaction with radiation, cavities with gain, Gaussian beams, light-emitting diodes, and semiconductor lasers.

Prior Course Number: 732

Transcript Abbreviation: Lasers

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad, Graduate

Student Ranks: Junior, Senior, Masters, Doctoral

Course Offerings: Autumn

Flex Scheduled Course: Never

Course Frequency: Odd Years

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: 3010 (312) and 3030 (432), or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

Exclusions: Not open to students with credit for 732.

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

Master physics of emission, absorption, and optical gain
Master physics of optical resonators, with and without gain
Master dynamics of lasing
Be competent in understanding gain and lasing in semiconductor lasers

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Review of electromagnetics	2.0							
Coherence	1.0							
Gaussian beams	2.0							
Guided optical beams	3.0							
Dispersion and attenuation	2.0							
Resonant cavities	3.0							
Einstein coefficients, lineshape	2.0							
Optical amplification and lineshape broadening	3.0							
Lasing dynamics, gain saturation	2.0							
Review of density of states, quasi-Fermi levels	3.0							
Semiconductor materials for diode lasers	2.0							
Double-heterojunction semiconductor lasers	2.0							
Gain-guided and index guided semiconductor lasers	4.0							
Quantum well lasers	4.0							
Strained quantum well lasers	2.0							
Strained quantum dot lasers	1.0							
Advanced semiconductor lasers	2.0							

Representative Assignments

Homework

Grades

Aspect	Percent
Homework	20%
Midterms (two)	50%
Final examination	30%

Representative Textbooks and Other Course Materials

Title	Author
<i>Laser Electronics</i>	Joseph Verdeyen
<i>Physics of Photonic Devices (recommended)</i>	Shunlien Chuang

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.

Course Contribution		College Outcome
*	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	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.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
*	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
*	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
*	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
*	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
**	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

Add more contents on semiconductor lasers. The second text book listed above is not required. Related materials will be distributed to the students by the teacher.

Change Spring to Autumn

Changed second book to specify "Recommended" to keep students from buying two books.
5/16/19 BLA

Added contributions to new ABET outcomes

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