

講義概要

科目基礎情報			
授業科目名	Photonics and opto-electronics		
英文授業科目名	Photonics and opto-electronics		
開講年度	2013年度	開講年次	3/4
開講学期	前学期	開講コース・課程	昼間コース
授業の方法	講義	単位数	2
科目区分			
開講学期・専攻	全学科		
担当教員名	上野 芳康		
居室	Room no. 310, Building no. West-2 (W2-310).		
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授業関連Webページ	http://www.ultrafast.ee.uec.ac.jp/ueno-classes.html		
更新日	2013/04/10 20:11:40	更新状況	公開中
講義情報			
主題および達成目標	<p>Modern photonics and electronics have been deeply spread to both academy and industry of our Real World, without country borders. It is because photonics and opto-electronics have realized terabit-per-second network infrastructures, optical-disk memories (DVD&CD's), compact and accurate laser diodes (from infrared to blue), and flat displays, in industry uses and home uses. In these science and technology, particle-based photonic properties of representative materials are almost always fully combined with their wave-based optical properties, in "bright" manners.</p> <p>In this course, typically 15 weeks, participants are expected to study and understand the scientific fundamentals of these photonic technology, and also to develop interests to on-going, long-term (i.e. large-scale) R&D activities in our world.</p>		
前もって履修しておくべき科目	<p>fundamentals of electro-magnetic waves (propagating in speed of light). fundamentals of electronics such as basic diodes and transistors.</p>		
前もって履修しておくことが望ましい科目	<p>fundamentals of quantum mechanics (particles and waves). fundamentals of crystalline materials and their basic, electronic properties.</p>		
教科書等	<p>(1) Saleh and Teich, Fundamentals of Photonics, second edition, John Wiley & Sons, Inc., 2007. (this is the primary textbook for this course.) (2) Amnon Yariv, Optical Electronics in Modern Communications, 5th edition, Oxford University Press, 1997. (the secondary textbook.) *1) UEC's main library and UEC-CIPE's library holds total eleven (3+3+5) copies of the above textbook (1). Authorized participants to this course this year may borrow one copy, officially. Number of participants will be around ten (might be less than 10). *2) Textbook (1) is relatively thick, consisting of 24 chapters. Never try to study all of these, from its beginning through the end, because that is the least exciting way! In this course, basic portions in chapters 12-18 are selected by lecturer Ueno so that it fits to industry and R&D in coming 10-20 years. *3) Table of contents of the above textbook (1): http://www.amazon.ca/gp/reader/0471358320/ref=sib_dp_ptu/180-2038632-4885556#reader-link</p>		
授業内容とその進め方	<p>1st-5th weeks: (1) Areas of science and technology where photonics and opto-electronics play particularly important roles in our world. (2) Representative photonic devices and materials that many of us must use and rely on, in these areas of science and technology.</p>		

<p>授業内容とその進め方</p>	<p>(3) Fundamental properties of silicon and other few important types of semiconductor crystals. Basics of direct transition (for light-emitting diodes and lasers), in contrast to indirect transition (for sensors and solar cells, for example).</p> <p>Then, basics of quantum-particle-based properties such as conservation laws in unit of electron-volts, in contrast to quantum-wave-based properties. (All of these are well understood and designed in all LED's, laser diodes, optical sensors, solar cells, for example.)</p> <p>6th-10th weeks:</p> <p>(4) General relationship from electrons to electron waves. That from lightwaves (em waves) to photons.</p> <p>(5) Device's internal structures (of light-emitting diodes and light-absorbing sensors), and their working principles.</p> <p>(6) Energy conversion law and general limits in energy-conversion efficiency, from electronic energy to photonic energy. That in the opposite direction, that is, from photonic energy to electronic energy.</p> <p>11th-15th weeks:</p> <p>(7) advanced groups of lasers, consisting of cavities and waveguides, which are deeply and broadly used in advanced systems such as network infrastructures (terabit per second), optical-disk memories (DVD&CD's), compact and accurate laser diodes (from infrared to blue).</p> <p>(8) high-density light energy in time and 3D-space dimensions (total four dimensions), that is rather simply generated by laser oscillators in particular. (Several kinds of experimental research are going on in our UEC</p>
<p>授業時間外の学習 (予習・復習等)</p>	<p>Both personal and group studies, efficiently before and after each weekly classroom, are encouraged.</p>
<p>成績評価方法 および評価基準 (最低達成評価基準を含む)</p>	<p>Understanding level of each student is evaluated, in the final test in the end of the 15-week course.</p>
<p>オフィスアワー： 授業相談</p>	<p>6th period, Tuesdays. (Notify me Ueno by email, when I was not available in the period of tuesday.)</p>
<p>学生へのメッセージ</p>	<p>The number of participants to this course will be around 10, too, and, could be slightly less. So, this lecturer Ueno welcomes questions from participants sometimes in the middle of 90 minutes, rather than after it. Your asking good questions to lecturer inspires the other participants, too, basically.</p>
<p>その他</p>	<p>Lecturer Ueno's international activities: http://www.ultrafast.ee.uec.ac.jp/ueno-cv.html</p>
<p>キーワード</p>	<p>photonics, opto-electronics, quantum mechanics, electro-magnetic waves, light-emitting diodes (spontaneous emission), lasers (stimulated emission), optical sensors, solar batteries, silicon, gallium arsenide, semiconductor.</p>