Akashi College	Year	2022	Course Title	Optoelectronics Devices

Course Information

Course Code	4035	Course Category	Specialized / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Mechanical and Electronic System Engineering	Student Grade	Adv. 2nd
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor	SUYAMA Taikei		

Course Objectives

1) Can explain the basics of quantum mechanics and semiconductors, and the interaction between optical waves and electrons as the basis for optical devices.
2) Understand the operating principles and characteristics of various light emitting devices, photosensitive devices, and solid-state display devices and can explain the important properties systematically.
3) Can construct an experimental system for the given lab assignment, using knowledge and technology from one's field of specialty.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understand and can apply the basic characteristics of light, quantum mechanics, and semiconductors.	Understand the basic characteristics of light, quantum mechanics, and semiconductors.	Do not understand the basic characteristics of light, quantum mechanics, and semiconductors.
Achievement 2	Understand the interaction between light waves and electrons and can solve problems.	Understand the interaction between light waves and electrons.	Do not understand the interaction between light waves and electrons.
Achievement 3	Understand the basic principles and applications of optical devices such as optical waveguides, LEDs, and lasers.	Understand the basic principles of optical devices such as optical waveguides, LEDs, and lasers.	Do not understand the basic principles of optical devices such as optical waveguides, LEDs, and lasers.
	Understand and can explain in detail photosensitive and display devices, optical fibers, optical communication, optical measurement and medical applications, optical power applications, etc.	Understand photosensitive and display devices, optical fibers, optical communication, optical measurement and medical applications, optical power applications, etc.	Do not understand photosensitive and display devices, optical fibers, optical communication, optical measurement and medical applications, optical power applications, etc.

Assigned Department Objectives

Teaching Method

Outline	Optical electronics is the fusion of optical technology, quantum electronics engineering, and electronics engineering. It has helped diversify and improve the performance of electronic engineering functions and has a wide range of content. Optical devices make up the core devices within this, and this technology has advanced significantly. In this course, the first half will focus on the basics and theory of optical devices. The second half will explain various optical devices used for optical information transmission, optical recording, and image information technology using the latest information.
Style	Students who miss 1/3 or more of classes will not be eligible for a passing grade The overall evaluation will be based 80% on periodic exams and 20% on report assignments. The minimum score for a pass will be 60%. The periodic exam will assess students' level of understanding of the class content. There will be only one exercise and it will assess whether Course Objective 2) has been achieved.
Notice	This course's content will amount to 90 hours of study in total. These hours include the learning time guaranteed in classes and the standard self-study time required for pre-study / review, and completing assignment reports. It is recommended that students have mastered subjects related to electronic properties. Students who miss 1/3 or more of classes will not be eligible for a passing grade.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Optical electronics and optical devices Optical electronics is a technology whose characteristic has three sides: Telecommunications engineering, imaging engineering, and light energy. Based on this, describe the form of optical devices, which make up the core of this field.	Optical electronics and optical devices Understand the form of optical electronics.
		2nd	Fundamental properties of light Review the basic properties of light (refraction, reflection, interference, diffraction, polarization, etc.) that have been learned so far in physics, etc.	Understand the fundamental properties of light.

		3rd	Basics of quantum mechanics Describe the background of quantum mechanics development, the dual nature of particles and waves of matter, the wave equation of the Schrödinger equation, and wave functions, which make up the theoretical background of quantum mechanics required to understand the interaction between optical waves and electrons.	Understand the basics of quantum mechanics.
		4th	Optical properties of semiconductors Materials absorb and emit light. This is mainly due to interactions between electrons in substances. Think phenomenologically about light absorption and emission in semiconductors.	Understand light absorption and emission in semiconductors.
		5th	Electrical properties of semiconductors Describe the electrical properties of semiconductors, which form the basis of optical devices.	Understand the electrical properties of semiconductors.
		6th	Quantum theory of the interaction between light waves and electrons Think about a method of quantum mechanical representation of the interaction between light and electrons. Derive the polarization factor of a material (the real part that indicates the accumulation of energy and the imaginary part that represents absorption and stimulated emission) by the second-order system approximation using a density matrix.	Understand the quantum theory of the interaction between light waves and electrons.
		7th	Quantum theory of the interaction between light waves and electrons (electron transition and stimulated emission) Derive the rate equation representing the percentage of temporal changes in photon and electron density based on the analysis of the light wave amplification process from the previous week. Think about the polarization of the multi-level system, based on this.	Understand electronic transitions and stimulated emission.
		8th	Exercise	Exercise
	2nd Quarter	9th	Photoelectric waveguides Using mainly light approximation for the analysis of photoelectric waveguide, describe topics such as an optical waveguide's basic properties (total reflection, waveguide mode, equivalent refractive index, containment coefficient, power matching of light propagation, light gathering and emission), power matching of light propagation and bending loss, power matching conditions for light propagation, mode matching conditions, and bluster angle and bending loss.	Photoelectric waveguides Using mainly light approximation for the analysis of photoelectric waveguide, understand topics such as an optical waveguide's basic properties (total reflection, waveguide mode, equivalent refractive index, containment coefficient, power matching of light propagation, light gathering and emission), power matching of light propagation and bending loss, power matching conditions for light propagation, mode matching conditions, and bluster angle and bending loss.
		10th	Periodic structures and light concentration and projection Explain periodic structures and photonic crystals. Understand light concentration and projection.	Understand periodic structures, light concentration and projection, periodic structures and photonic crystals, and light concentration and projection.
		11th	Light emitting diodes Describe the structure, production methods, and materials of light emitting diodes (LEDs), one of the important light emitting devices. Explain its light emitting characteristics and features and think about its current problems.	Understand the principles of light emitting diodes.
		12th	Semiconductor lasers Explain the properties of semiconductor lasers as a light sources and determine an oscillation threshold, optical output, oscillation wavelength, amplification gain, and so on. Describe the structure, type, emission characteristics, etc. of semiconductor lasers (LD).	Understand the principles of semiconductor lasers.
		13th	Photosensitive and display devices Describe the structure, properties, and features of photosensitive devices such as photodetectors, photodiodes, solar cells, etc. Describe display devices with a focus on LCDs.	Understand the structure, properties, and features of photodetectors, photodiodes, solar cells, etc.
		14th	Optical fiber lines and optical components Describe optical fiber and device bonding, optical circuit elements, optical polarizers, etc.	Understand optical fiber and device bonding, optical circuit elements, optical polarizers, etc.
		15th	Applications of optical devices Describe topics with a focus on optical communications, optical measurement and medical applications, optical power generation, etc.	Understand the applications of optical devices.
		16th	Final exam	Final exam

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Exercise	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100

Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0