[Title]			[Instructor]		
Advanced Optical and Acoustic Waves Engineering			Shoji Kakio / Satoshi Honma		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE501	2	Electrical and Electronic Engineering	1st Semester	Wed.／I	Japanese

[Outline and purpose]

Light and radio wave are used to carry a signal in modern optical and wireless communications, respectively. This class provide explanation of basic property of electromagnetic filed and its applications to communication/measurement techniques using wave characteristics. This class also introduce the advanced topics of optical devices such as light generators, detectors, and analyzers, and specific systems such as optical communication and information processing.

[Objectives]

1. to understand the nature of the phenomenon of wave movement and to express its characteristics mathematically
2. to derive wave equations from Maxwell equations and further apply boundary conditions
3. to analysis light wave propagating in free space and wave-guide.

[Requirements]

Requirements for admission to the course are basic mathematical knowledge such as calculus, linear algebra, and basic analysis and electromagnetics engineering.

[Evaluation]

1. Final Exam：100%

[Textbooks]

[References]

[Schedule]

1. Maxwell equation and Basics of vector operation
2. Derivation of wave equation for plane wave, and its phase velocity
3. Fourier optics and beam propagation analysis in free space
4. Fourier beam propagation method and Fresnel–Kirchhoff integral theorem(1)
5. Fourier beam propagation method and Fresnel–Kirchhoff integral theorem(2)
6. Optical lens and Fourier transform (1)
7. Optical lens and Fourier transform (2)
8. Polarization and Fresnel coefficients
9. 2-wave interference / multiple interference
10. Wave propagation in wave-guide
11. Transmission dispersion equation and dispersion curve by waveguide
12. Electromagnetic field distribution of guided mode
13. Mode coupling (co-directional coupling)
14. Mode coupling (contra-directional coupling)
15. Final examination

[Title]			[Instructor]		
Advanced Electronic Device Engineering			Norio Onojima / Koji Yano/ Masayuki Yamamoto		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE503	2	Electrical and Electronic Engineering	2nd Semester	Thu.／I	

[Outline and purpose]

This course provides the knowledge to understand the principle of semiconductor devices as key devices for highly information-oriented society in recent years.

[Objectives]

1. To understand the fundamental physics of organic semiconductor-based electronic devices compared with inorganic counterparts
2. To understand the fundamental physics of semiconductor power devices and their application

[Requirements]

Basic knowledge of Electromagnetism and Semiconductor Engineering

[Evaluation]

Test / Report 100%

[Textbooks]

Original text will be used.

[References]

Appropriate references will be introduced during the course.

[Schedule]

(1) Overview of organic electronics
(2) Fundamental physics of organic semiconductors
(3) Carrier-transport mechanism in organic semiconductors
(4) Device physics of organic transistors
(5) Fabrication process of organic transistors
(6) Applications of organic transistors
(7) Introduction of organic semiconductor-based optoelectronic devices
(8) Trend of power device development
(9) Structure and physics of pin diode
(10) Structure and physics of power MOSFET
(11) Structure and physics of IGBT
(12) Structure and physics of superjunction power device
(13) Wide bandgap power devices : SiC power devices
(14) Wide bandgap power devices : GaN power devices
(15) Final examination

[Title]			[Instructor]		
Advanced Crystal Engineering			Tsutomu Muranaka / Yoichi Nabetani		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE504	2	Electrical and Electronic Engineering	2nd Semester	Mon.／II	Japanese

[Outline and purpose]

Crystal engineering, the design and formation of solid-state structures, is a key technology for semiconductor devices used in various optical and electronic applications. This course provides the knowledge of crystal growth and processes for semiconductor device fabrication. You will learn up-to-date information about crystal growth and processes for semiconductor device fabrication from R&D phase to industrial product phase.

[Objectives]

By the end of the course, you will be able to understand and describe the bases of crystal growth and processes for semiconductor device fabrication. Also you will be able to understand and describe many kinds of semiconductor technology in today's world.

[Requirements]

It is desirable that you have learned the bases of calculus, physics, inorganic chemistry and semiconductor devices.

[Evaluation]

Test / Report 100%

[Textbooks]

Original text will be used.

[References]

References written in Japanese are shown in the Japanese syllabus.
Simon M. Sze and Ming-K. Lee, Semiconductor Devices: Physics and Technology, Third Edition, Wiley (ISBN: 978-0470537947)

[Schedule]

01. Introduction to crystal growth and epitaxy
02. Fundamentals of epitaxial growth
03. Materials for epitaxial growth
04. Methods of epitaxial growth
05. Equipment for epitaxial growth
06. Characterization of epitaxial growth: Structural properties
07. Characterization of epitaxial growth: Optical properties
08. Characterization of epitaxial growth: Electrical properties
09. Single crystal growth of silicon: Czochralski method
10. Single crystal growth of silicon: Float zone method
11. Physics and technology of silicon MOSFET
12. Process for semiconductor device fabrication: Oxidation and deposition
13. Process for semiconductor device fabrication: Metallization
14. Process for semiconductor device fabrication: Lithography and etching
15. Final examination

[Title]			[Instructor]		
Advanced Crystal Engineering			Yoichi Nabetani / Tsutomu Muranaka		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE504	2	Electrical and Electronic Engineering	2nd Semester	Mon.／II	Japanese / English

[Outline and purpose]

Crystal engineering, the design and formation of solid-state structures, is a key technology for semiconductor devices used in various optical and electronic applications. This course provides the knowledge of crystal growth and processes for semiconductor device fabrication. You will learn up-to-date information about crystal growth and processes for semiconductor device fabrication from R&D phase to industrial product phase.

[Objectives]

By the end of the course, you will be able to understand and describe the bases of crystal growth and processes for semiconductor device fabrication. Also you will be able to understand and describe many kinds of semiconductor technology in today's world.

[Requirements]

It is desirable that you have learned the bases of calculus, physics, inorganic chemistry and semiconductor devices.

[Evaluation]

Test / Report 100%

[Textbooks]

Original text will be used.

[References]

References written in Japanese are shown in the Japanese syllabus.
Simon M. Sze and Ming-K. Lee, Semiconductor Devices: Physics and Technology, Third Edition, Wiley (ISBN: 978-0470537947)

[Schedule]

01. Introduction to crystal growth and epitaxy (Y. Nabetani)
02. Fundamentals of epitaxial growth (Y. Nabetani)
03. Materials for epitaxial growth (Y. Nabetani)
04. Methods of epitaxial growth (Y. Nabetani)
05. Equipment for epitaxial growth (Nabetani)
06. Characterization of epitaxial growth: Structural properties (Y. Nabetani)
07. Characterization of epitaxial growth: Optical properties (Y. Nabetani)
08. Characterization of epitaxial growth: Electrical properties (Y. Nabetani)
09. Single crystal growth of silicon: Czochralski method (T. Muranaka)
10. Single crystal growth of silicon: Float zone method (Muranaka)
11. Physics and technology of silicon MOSFET (T. Muranaka)
12. Process for semiconductor device fabrication: Oxidation and deposition (T. Muranaka)
13. Process for semiconductor device fabrication: Metallization (T. Muranaka)
14. Process for semiconductor device fabrication: Lithography and etching (T. Muranaka)
15. Final examination (Y. Nabetani / T. Muranaka)

[Title]			[Instructor]		
Advanced Signal and Systems Engineering			Makoto Ohki / Masanori Hanawa		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE505	2	Electrical and Electronic Engineering	1st Semester	Tue.／II	Japanese / English

[Outline and purpose]

Digital Signal Processing (DSP) techniques are widely applied in modern information and communication systems. This class covers a wide range of DSP techniques from fundamentals to applications, including fundamentals on signals and systems analysis, Discrete Fourier Transform or Fast Fourier Transform, digital filter design techniques, adaptive signal processing, multi-dimensional signal processing, and state-of-the-art DSP techniques used in digital coherent fiber-optic communication systems such as phase estimation, constant modulus algorithm and digital backpropagation techniques and so on.

[Objectives]

1. to understand the purpose of signal processing
2. to analysis signals and systems using the Fourier transform, the Laplace transform and the z-transform
3. to design basic filters
4. to explain the purpose and the characteristics of advanced signal processing techniques

[Requirements]

Fundamental knowledge of mathematics such as calculus, linear algebra and complex number. Usage of MATLAB

[Evaluation]

1. midterm examination or report: 50%
2. final examination or report: 50%

[Textbooks]

1. J. H. McClellan, R. W. Schafer, and M. A. Yoder, DSP First Second Edition, Prentice Hall, 2015.
2. Sayed, Ali H., Adaptive Filters, Wiley, 2008.
3. M. Nakazawa, K. Kikuchi, T. Miyazaki, High Spectral Density Optical Communication Technologies, Springer, 2010.

[References]

Additional reading assignments would be given arbitrarily.

[Schedule]

1. Signals and systems
2. Fourier transform and frequency domain analysis
3. Fundamentals on digital filters
4. Digital filter design
5. Statistical signal processing and optimal filters
6. Adaptive signal processing
7. Arrayed signal processing
8. Multi-dimensional filters and nonlinear filters

(The above eight classes would be given by Prof./Dr. Makoto Ohki)

9. Shannon’s channel capacity and brief overview of fiber-optic communication systems
10. Lasers and optical fibers
11. External optical modulators including intensity modulators, phase modulators, and quadrature modulators
12. Optical amplifiers and wavelength division multiplexing techniques
13. Multi-level modulation formats and phase diversity receivers
14. Linear and non-linear distortions under transmission in optical fibers
15. Impairments compensation techniques

(The above seven classes would be given by Prof./Dr. Masanori Hanawa)

[Title]			[Instructor]		
Advanced Signal and Systems Engineering			Masanori Hanawa		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE505	2	Electrical and Electronic Engineering	1st Semester	Tue.／II	Japanese / English

[Outline and purpose]

Digital Signal Processing (DSP) techniques are widely applied in modern information and communication systems. This class covers a wide range of DSP techniques from fundamentals to applications, including fundamentals on signals and systems analysis, Discrete Fourier Transform or Fast Fourier Transform, digital filter design techniques, adaptive signal processing, multi-dimensional signal processing, and state-of-the-art DSP techniques used in digital coherent fiber-optic communication systems such as phase estimation, constant modulus algorithm and digital backpropagation techniques and so on.

[Objectives]

1. to understand the purpose of signal processing
2. to analysis signals and systems using the Fourier transform, the Laplace transform and the z-transform
3. to design basic filters
4. to explain the purpose and the characteristics of advanced signal processing techniques

[Requirements]

Fundamental knowledge of mathematics such as calculus, linear algebra and complex number. Usage of MATLAB

[Evaluation]

Students will pass if they have completed 80% or more of the class reflections and assignments.

[Textbooks]

1. J. H. McClellan, R. W. Schafer, and M. A. Yoder, DSP First Second Edition, Prentice Hall, 2015.
2. Sayed, Ali H., Adaptive Filters, Wiley, 2008.
3. M. Nakazawa, K. Kikuchi, T. Miyazaki, High Spectral Density Optical Communication Technologies, Springer, 2010.

[References]

Additional reading assignments would be given arbitrarily.

[Schedule]

1. Signals and systems
2. Fourier transform and frequency domain analysis
3. Fundamentals on digital filters
4. Digital filter design
5. Statistical signal processing and optimal filters
6. Adaptive signal processing
7. Arrayed signal processing
8. Multi-dimensional filters and nonlinear filters
9. Shannon's channel capacity and brief overview of fiber-optic communication systems
10. Lasers and optical fibers
11. External optical modulators including intensity modulators, phase modulators, and quadrature modulators
12. Optical amplifiers and wavelength division multiplexing techniques
13. Multi-level modulation formats and phase diversity receivers
14. Linear and non-linear distortions under transmission in optical fibers
15. Impairments compensation techniques

[Title]			[Instructor]		
Advanced Electronic Circuits Engineering			Takahide Sato/Naoto Sekiya		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE506	2	Electrical and Electronic Engineering	2nd Semester"	Mon.／II	Japanese / English

[Outline and purpose]

In this lecture, you will learn about "integrated circuit design" and "high frequency circuit". The purpose of "integrated circuit design" is to acquire practical circuit design technology for integrated circuits. Students will learn more practical circuit configurations such as points to keep in mind when designing noise and stability. In "High Frequency Circuits", you will learn how to design various passive circuits using microstrip lines. In addition, an electromagnetic field simulator will be used in the lecture to gain a visual understanding.

[Objectives]

1. to explain the noise in an integrated circuits.
2. to analyze the noise in the circuit.
3. to explain the microstrip line structure.
4. to design a filter using a 1/4 wavelength stub circuit
5 to explain and design directional couplers.

[Requirements]

Basic knowledge of electric circuit, electromagnetism, integrated circuit design and high frequency circuit is necessary. For example, students are required to have the knowledge about designing a common source amplifier and a differential amplifier using MOSFETs.

[Evaluation]

final examination or report: 100%

[Textbooks]

Printed materials about lecture topics will be distributed during the lecture.

[References]

Additional reading assignments would be given arbitrarily.

[Schedule]

1. Introduction
2. Definitions of noise
3. Noise of amplifier, source follower and cascode
4. Noise of current mirror and differential pair
5. Noise matching
6. Stability of operational amplifiers
7. Pole splitting and compensation of positive zero
8. Stability of 3-stage Opamp

(The above eight classes would be given by Dr. Takahide Sato)

9. Basic concept of high frequency circuit

10 Basic concept of maicrostrip line circuit and electromagnetic simulator

11. Design of 1/4 λ stub circuit (BPF and BRF)
12. Design of directional coupler
13. Design of resonator coupled filter
14. Recent progress on microstrip line filters
15. Recent progress on wireless power transfer

(The above seven classes would be given by Dr. Naoto Sekiya)

[Title]			[Instructor]		
Advanced Measurement Engineering			Chen Lee Chuin / Satoshi Ninomiya		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE507	2	Electrical and Electronic Engineering	1st Semester	Thu.／II	Japanese/English

[Outline and purpose]

Sensing and measurement are indispensable to the advancement of science and technology as if the human sensory system to our daily life. The measurement technologies have multiple impacts on the development of basic sciences as well as on the commercial R&D. In this course, student will learn about the latest development and the fundamental principle behind the widely used scientific instruments such as electron microscope, electron spectroscope and mass spectrometer. Recent research topics on the in-situ biological analysis and imaging mass spectrometry will also be reviewed.

[Objectives]

Describe the related vacuum technologies used in the advanced measurement instrument.
Explain the principles behind the measurement and sensing technologies.
Describe the application of measurement technologies in the pursuit of basic science and commercial R&D.

[Evaluation]

Test, quiz and report (70%)
Attendance and learning attitude (30%)

[Textbooks]

Materials and lecture notes will be distributed.

[References]

Nil

[Schedule]

1. General introduction
2. Fundamentals of vacuum technology
3. Vacuum analysis and measurement
4. High voltage and gaseous breakdown
5. Electron beam technology
6. X-ray beam analytical technology
7. Optical beam technology
8. Ion beam technology
9. Scanning probe technology
10. Mass spectrometry and ionization methods
11. Isotope analysis
12. Surface and interface analysis
13. Sensors and Detectors
14. In-situ biological analysis and imaging mass spectrometry
15. Review and conclusion

[Title]			[Instructor]		
Advanced Electrical Power Engineering			Kazuyuki Uno		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE508	2	Electrical and Electronic Engineering	1st Semester	Fri.／I	Japanese

[Outline and purpose]

The Great East Japan Earthquake in 2011 gave big damage to nuclear power plants and was a trigger of a big paradigm shift of an energy supply system. This course provides an introduction to energy systems and renewable energy resources with a scientific examination of the energy field. The course explores society's present needs and future energy demands and focuses on electric power generation, electric power transmission and energy conversion.

[Objectives]

Students completing the course will

1. be able to explain about history of electric energy, electric power generation, electric power transmission, power use, and energy conversion.
2. be able to explain about energy resource, fossil energy, and nuclear energy.
3. be able to explain about thermal energy and heat pump technology.
4. be able to explain about chemical energy, fuel cell, and hydrogen energy system.

[Requirements]

Requirements for admission to the course are basic knowledge of high voltage engineering, electric engineering, and physics.

[Evaluation]

Quizzes and homework assignments 35%
Final examination and presentation 65%

[Textbooks]

1. Makoto Katsurai, 基礎エネルギー工学, Suurikougakusha-sha, ISBN4901683047

[References]

1. S. T. Pai and Qi Zhang, Introduction to high power pulse technology, World Scientific, ISBN9810217145

[Schedule]

1. Work, energy, and power revolution
2. Current status and problems of primary energy, and quizzes
3. History of electric energy
4. Electricity business in Japan
5. Electric power generation, electric power transmission, and energy conversion
6. Power electronics technology and quizzes
7. Energy resource
8. Nuclear energy
9. Nuclear fusion and quizzes
10. Thermal dynamics
11. Thermal dynamics in thermal power generation and nuclear power generation
12. Heat pump technology and quizzes
13. Chemical energy and battery
14. Hydrogen energy and fuel cell
15. Final examination and presentation

[Title]			[Instructor]		
Advanced Power Semiconductor Modules Engineering			Y. Ikeda, N. Eguchi et al.		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE509	2	Electrical and Electronic Engineering	1st Semester	Tue.／III	Japanese

[Outline and purpose]

Semiconductor power device is a key technology supporting today's our life from home-electronics to cars, trains and industries. Researchers and engineers in the forefront of major power-device industry give lectures on physics and technology of power semiconductor devices emphasizing packaging technology. You will learn up-to-date state of power devices from R&D phase to industrial product phase.

[Objectives]

By the end of the course, you will be able to understand and describe basic power-device characteristics, thermal and structural design and insulation technique of power modules, and reliability of power modules. Also you will be able to understand and describe many kinds of power-electronics equipment in today's world.

[Requirements]

It is desirable that you have bases of Semiconductor devices, Electrical circuit, Electronic circuit and Electro magnetism.

[Evaluation]

1. Final Exam : 35%, 2. Midterm Exam : 15%, 3. Small Quizzes /Reports : 10%
4. Attendance/Behavior in Class : 20% 5. Presentation : 20%

[Textbooks]

[References]

[Schedule]

1. Basic physics of power semiconductor modules
2. Thermal and structural design of power semiconductor modules
3. Insulation technique of power semiconductor modules
4. Tour of Matsumoto Factory and Omachi Factory of Fuji Electric Co.
5. Materials and reliability of power semiconductor modules
6. Power Electronics -how to use power devices-
7. The latest trend of power transforming equipment (Electric car, inverter, UPS)
8. Tour of Tokyo Factory of Fuji Electric Co.
9. Application of power transforming equipment (Shinkansen train etc.)
10. Future of power semiconductors and power electronics
11. Tour of Yamanashi Factory of Fuji Electric Co.