[Title]			[Instructor]		
Complex Analysis			Kiyoshi Kobayashi / Ichiro Shiraki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322024	2	Electrical and Electronic Engineering	2nd Semester	Thu.／II	English／Japanese

[Outline and purpose]

The course provides an introduction to complex analysis and variational method that will be essential for EE students to be mastered.

[Objectives]

To master the basic concepts of complex analytic functions and those of functional, variational methods.
To apply those concepts and methods to fundamental problems.

[Requirements]

Calculus

[Evaluation]

There is a final examination for evaluation.

[Textbooks]

Original text is used.

[References]

Appropriate references are specified during the course.

[Schedule]

I. Complex Analysis
1. Complex function
2. Cauchy's integral expression and complex integrals
3. Partial differential equation and Green’s function

II. Variational methods
1. Extrema
2. Local minimum of functional integral
3. Constraints

[Title]			[Instructor]		
Thermal and Statistical Physics			Kiyoshi Kobayashi / Chikako Uchiyama		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322044	2	Electrical and Electronic Engineering	1st Semester	Thu.／II	English／Japanese

[Outline and purpose]

This course provides an introduction to basic principles in thermodynamics and statistical mechanics.

[Objectives]

To examine the laws of thermodynamics and the concepts of temperature, work, heat, and entropy, postulates of classical statistical mechanics, microcanonical, canonical, and grand canonical distributions.

[Requirements]

Basic Statistics(252051)
Quantum Mechanics(262028)

[Evaluation]

There will be one midterm (for thermodynamics) and one final exam (for statistical mechanics) exams.

[Textbooks]

“Netsu-toukeirikigaku “ (ISBN=4000076477) by M. Toda in Japanese

[References]

[Schedule]

1. **Thermodynamics–1:** basic concepts
2. **Thermodynamics–2:** the first law of thermodynamics
3. **Thermodynamics–3:** the second law of thermodynamics
4. **Thermodynamics–4:** kinetic theory of gases
5. **Probability Theory:** probability densities, application to ideal and van der Waals gas
6. **Classical Statistical Mechanics:** microcanonical, canonical and grand canonical ensembles;
7. **Quantum Statistical Mechanics–1:** quantization; application to phonons, photons; density matrix formulation
8. **Quantum Statistical Mechanics–2:** quantum gases;

[Title]			[Instructor]		
Advanced Course in Optical Engineering			Hirokazu Hori / Satoshi Honma		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322064	2	Electrical and Electronic Engineering	1st Semester	Fri.／III	English／Japanese

[Outline and purpose]

Optical engineering is essential for developments in modern science and technologies. To understand physical background and typical applications of modern optics-based science and technologies, students will be provided with theoretical foundations and selected topics related to light sources, photo detectors, apparatus for optical diagnosis, and systems for optical information transfer and processing.

・Theoretical bases of optics

Development in modern optics and photonics, Light waves and dispersion relations, Space and dual space, Light waves and interference, Wave vector and polarizations, Electromagnetic waves in material medium, Optical response of matter, Basic geometric optics theory, reflection, refraction, diffraction, optical lens and imaging characteristics and optical materials

・Selected topics

Near-field optics, Optical information transfer, Optical wave-guide, Fundamental process of light emission, Light sources and photo detectors, Laser and coherent light, optical material and the characteristics, Optical cavity and quantum field theory, Optical modulator, optical storage and optical fabrication, optical non-liner effect

・Extended topics

Optics and standards, Optical crystal, Holography, Modern techniques of optics-based measurements, Topics in quantum optics, , Waves in general

[Objectives]

To understand principles of modern optics and electromagnetic interactions.
To understand basic schemes of optical engineering.
To develop skills in handling optical problems and optics-based applications in modern technologies.

[Requirements]

Fundamentals of electrodynamics.

[Evaluation]

Final examination: 100%

[Textbooks]

光学入門，共立出版．ISBN:4320034198 (in Japanese)

[References]

Specified during the course

[Schedule]

1. Development in modern optics and photonics, Light waves and dispersion relations, Optics and standards
2. Space and dual space, Light waves and interference, Optical waves and applications
3. Optical cavity and quantum field theory, Fundamental process of light emission, Laser and coherent light
4. Wave vector and polarizations, Optical information transfer, Waves in general
5. Electromagnetic waves in material medium, Light sources and photo detectors, Near-field optics
6. Optical response of matter, Modern techniques of optics-based measurements, Topics in quantum optics
7. Optical modulator and non-linear optics in modern optics
8. Basic geometric optics theory, reflection, refraction, diffraction
9. Optical lens and imaging characteristic, optical wave-guide
10. Optical crystal, non-linear optical effect
11. Optical memory and optical fabrication
12. Optical crystal and applications to optical devices,
13. Final examination

[Title]			[Instructor]		
Advanced Electronic Circuits Engineering			Takahide Sato		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTE506	2	Electrical and Electronic Engineering Embedded and Integrated System Development	2nd Semester"	Mon.／I	Japanese / English

[Outline and purpose]

Very Large Scaled Integrated circuits（VLSI）are widely used in modern electronics systems to achieve their sophistication, miniaturization and high reliability. The goal of this class is to learn how to design the latest and practical mixed signal integrated circuits. This class covers wide range of VLSI circuit design technique from fundamentals to applications, including fundamentals on MOS Transistor and its analysis, Operational amplifiers, Filters, Data convertors, Phase lock loop and so on. Furthermore, the trend of circuit design technique using discrete devices including switching DC-DC convertor design is also lectured.

[Objectives]

1. to explain characteristics and usage of MOSFETs.
2. to design a basic analog integrated circuits used in analog integrated circuits.
3. to explain and design an operational amplifier, a filter, ADC and PLL.
4. to analyse a DC-DC convertor.

[Requirements]

Basic knowledge of electric circuit, electronic circuit and circuit theory

[Evaluation]

final examination or report: 100%

[Textbooks]

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

[References]

[Schedule]

1. Basis theorem of electronical circuits
2. MOSFET
3. Single stage amplifier
4. Operational amplifiers 1 (General considerations, Performance parameters)
5. Operational amplifiers 2 (Two stage operational amplifiers, Slew rate, Noise)
6. Filters 1 (Performance parameters, Design of transfer function)
7. Filters 2 (Active filter, Switched capacitor filter)
8. Digital to analog convertors
9. Analog to digital convertors
10. Oscillators and PLL
11. Simulator and Layout design
12. Power supply circuits 1 (Invertor, DC-DC convertor)
13. Power supply circuits 2(Analysis of a DC-DC convertor)

[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 Embedded and Integrated System Development	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 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 back propagation 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 Digital Circuit			Makoto Ohki / Takahide Sato		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322094	2	Electrical and Electronic Engineering Embedded and Integrated System Development	1st Semester	Tue.／I	Japanese

[Outline and purpose]

A top-down design method of the digital circuit by using hardware description languages, such as VHDL is studied in this lecture. Fundamental computer architecture is also explained and a part of it are described by VHDL and realized by CPLD and/or FPGA as a training.
Purposes of this lecture are as follows;
1. to understand basic concepts and structure of a computer, and operation of CPU
2. to understand methodology of design of a digital circuit by using HDL
3. to understand the characteristics of PLD, FPGA and gate array
4. to understand a concept of circuit verification using simulator

and so on.

[Objectives]

1. to describe some basic logic circuits by VHDL
2. to write a program source which simulate a digital circuit written in VHDL
3. to understand basic operation of a computer
4. to write an object program to a test board using CPLD and execute it.

[Requirements]

Knowledge of “Digital circuit” and “computer architecture” is required.

[Evaluation]

Mini- test / Report 100%

[Textbooks]

VHDL によるマイクロプロセッサ設計入門, CQ 出版, ISBN:4789833631 (in Japanese)

[References]

[Schedule]

1. Design methodology of a digital circuit
2. Basic structure of a computer
3. Structure and contents of CPU
4. Operation of CPU No.1
5. Operation of CPU No.2
6. Operation of CPU No.3
7. Operating system
8. Combinational circuit and its description in HDL
9. Operation circuit
10. Flip Flop and its description in HDL
11. Sequential circuit and its description in HDL
12. Description of CPU in HDL and exercise No.1
13. Description of CPU in HDL and exercise No.2

[Title]			[Instructor]		
Communication Devices Using Optical and Acoustic Waves			Shoji Kakio / Norio Onojima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322164	2	Electrical and Electronic Engineering	2nd Semester	Tue.／I	English／Japanese

[Outline and purpose]

Communication network technologies based on the Internet and mobile communication technologies such as a cellular phone are supported by communication devices using optical and acoustic waves. In this lecture, the basic theory and applications of the communication devices using optical and acoustic waves are explaned and disscussed

[Objectives]

1. To understand the physical phenomenon of the electrooptic and piezoelectric effects.
2. To understand the principle and feature of the communication devices using optical and acoustic waves.

[Requirements]

Basic knowledge of Infinitesimal calculus, Analysis, Linear algebra, Electromagnetism, and Electric circuit

[Evaluation]

Report：100%

[Textbooks]

[References]

[Schedule]

1. Communication devices using optical waves
1-1. Wave equation
1-2. Optical guided wave and guiding mode
1-3. Control of optical guided wave (electrooptic, magnetrooptic, and nonlinear effects)
1-4. Waveguide-type optical devices (optical modulator/switch and SHG devices)

2. Communication devices using acoustic waves
2-1. Equations of motion and piezoelectric in elastic
3-2. Elastic wave propagation and excitation/detection of elastic wave
3-3. Bulk wave devices (QCM, resonator, filter)
3-4. Surface acoustic wave devices (SAW filter, resonator, and oscillator)

3. Acoustooptic Interactions
3-1. Acoustooptic effects
3-2. Waveguide-type acoustooptic devices (Bragg deflector, frequency shifter, and AOTF)

[Title]			[Instructor]		
Seminar in Electric and Electronic Engineering IA			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322541	1	Electrical and Electronic Engineering	1st Semester		English／Japanese

[Outline and purpose]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. To report in a small seminar to be held regularly in each laboratory for its contents, we will deepen the study. As part of this process, to participate in the presentation related to English papers by the two-year master's students and the question-and-answer session is obliged. By knowing the background in the research of students of other laboratories, a better understanding of their background and their own research is expected.

[Objectives]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. You are required to be a result about the research.

[Requirements]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Evaluation]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Textbooks]

[References]

[Schedule]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed.
Subject related to the field and trend of research work in the each laboratory will be conducted

[Title]			[Instructor]		
Seminar in Electric and Electronic Engineering IB			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322542	1	Electrical and Electronic Engineering	2nd Semester		English／Japanese

[Outline and purpose]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. To report in a small seminar to be held regularly in each laboratory for its contents, we will deepen the study. As part of this process, the presentation about the content of English papers related to the research theme is obliged. By answering questions from other students and teaching staffs in other laboratories, you will develop an understanding of the research and its background.

[Objectives]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. You are required to be a result about the research.

[Requirements]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Evaluation]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Textbooks]

[References]

[Schedule]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed.
Subject related to the field and trend of research work in the each laboratory will be conducted.

[Title]			[Instructor]		
Seminar in Electric and Electronic Engineering IIA			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322551	1	Electrical and Electronic Engineering	1st Semester		English／Japanese

[Outline and purpose]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. To report in a small seminar to be held regularly in each laboratory for its contents, we will deepen the study. As part of this process, the presentation about the content of English papers related to the research theme is obliged. By answering questions from other students and teaching staffs in other laboratories, you will develop an understanding of the research and its background.

[Objectives]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. You are required to be a result about the research.

[Requirements]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Evaluation]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Textbooks]

[References]

[Schedule]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIA. The theme given by the master's thesis supervisor is surveyed, experimented and discussed.
Subject related to the field and trend of research work in the each laboratory will be conducted.

[Title]			[Instructor]		
Seminar in Electric and Electronic Engineering IIB			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322552	1	Electrical and Electronic Engineering	2nd Semester		English／Japanese

[Outline and purpose]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. To report in a small seminar to be held regularly in each laboratory for its contents, we will deepen the study.

[Objectives]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed. You are required to be a result about the research.

[Requirements]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Evaluation]

It is required to understand what you have learned in the master's program, and what you learned in the seminar.

[Textbooks]

[References]

[Schedule]

It is an exercise about what you learned in Research of Electrical and Electronic System Engineering IIB. The theme given by the master's thesis supervisor is surveyed, experimented and discussed.
Subject related to the field and trend of research work in the each laboratory will be conducted

[Title]			[Instructor]		
Research Work in Electric and Electronic Engineering IA			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322561	2	Electrical and Electronic Engineering	1st Semester	／	English／Japanese

[Outline and purpose]

Independent study for master thesis　under supervision

[Objectives]

To conduct thesis research for master program requirement

[Requirements]

Determined after discussion with each supervisor of student's interests

[Evaluation]

Supervisor's judgment

[Textbooks]

None

[References]

None

[Schedule]

As determined by consultation with each supervisor

[Title]			[Instructor]		
Research Work in Electric and Electronic Engineering IB			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322562	2	Electrical and Electronic Engineering	2nd Semester	／	English／Japanese

[Outline and purpose]

Independent study for master thesis　under supervision

[Objectives]

To conduct thesis research for master program requirement

[Requirements]

Determined after discussion with each supervisor of student's interests

[Evaluation]

Supervisor's judgment

[Textbooks]

None

[References]

None

[Schedule]

As determined by consultation with each supervisor

[Title]			[Instructor]		
Research Work in Electric and Electronic Engineering IIA			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322571	3	Electrical and Electronic Engineering	1st Semester	／	English／Japanese

[Outline and purpose]

Independent study for master thesis　under supervision

[Objectives]

To conduct thesis research for master program requirement

[Requirements]

Determined after discussion with each supervisor of student's interests

[Evaluation]

Supervisor's judgment

[Textbooks]

None

[References]

None

[Schedule]

As determined by consultation with each supervisor

[Title]			[Instructor]		
Research Work in Electric and Electronic Engineering IIB			All faculty		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
322572	3	Electrical and Electronic Engineering	2nd Semester	／	English／Japanese

[Outline and purpose]

Independent study for master thesis under supervision

[Objectives]

To conduct thesis research for master program requirement

[Requirements]

Determined after discussion with each supervisor of student's interests

[Evaluation]

Supervisor's judgment

[Textbooks]

None

[References]

None

[Schedule]

As determined by consultation with each supervisor