SYLLABUS *2018*

[E] Informatics and Mathematical Science

Kyoto University, Faculty of Engineering

[E] Informatics and Mathematical Science

Informatics and Mathematical Science

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91130

Introduction to Computer Science

計算機科学概論

【Code】91130 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Introduction to Computer Science.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Fundamentals of computer science	3-4	
Computer systems	6-7	
Informatics and AI	3-4	
Examination & review	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91140

Introduction to Applied Mathematics and Physics

数理工学概論

【Code】91140 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Basic ideas in applied mathematics and physics are introduced via topics on communications and reasoning, operation researches, and quantum information science.

【Grading】Evaluated by writing homework.

【Course Goals】Understanding basic ideas in applied mathematics and physics.

【Course Topics】

Theme	Class number of times	Description
	4	
	4	
	4	
reserved	3	

【Textbook】None

【Textbook(supplemental)】None

【Prerequisite(s)】None

【】

【Web Sites】

【Additional Information】

91150

Introduction to Algorithms and Data Structures

アルゴリズムとデータ構造入門

【Code】91150 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese 【Instructor】

【Course Description】Algorithms and data structures are two fundamental components of computer programs. This course gives their basic concepts, design principles, techniques, and other important concepts in computer science.

【Grading】Mid-term and final examinations

【Course Goals】The goals of the course is to understand: - mathematical models of computers and concepts of computational complexity, - basic algorithms and data structures, - design principles of algorithms, such as divide-and-conquer method and dynamic programming, - classes of hard problems and solutions to them, and - basic ideas of graph algorithms, approximation algorithms, and online algorithms.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Overview
algorithms	2.5	sorting, search, ...
data structures	2.5	list, stack, queue, binary search, heap, hash, ...
algorithm design	2	divide-and conquer, dynamic programming, ...
graph algorithms	2	- Trees and graphs - depth-/breadth-first search - shortest path algorithms - maximum-flow algorithms
computational complexity	3	P, NP, NP-complete, NP-hard, ...
advanced topics	1	approximation and online algorithms
final exam	1	

【Textbook】will be specified in the lectures

【Textbook(supplemental)】will be specified in the lectures

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90690

Linear Programming

線形計画

【Code】90690 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Lectures on modeling and algorithms of mathematical optimization, with main focus on linear programming, which is the most fundamental subject in system optimization.

【Grading】Based on the score of the term examination.

【Course Goals】To learn the basic ideas of formulating optimization models, and to understand theoretical properties and solution methods of linear programming.

【Course Topics】

Theme	Class number of times	Description
Introduction to Mathematical Optimizaiton	1	Introduction to Mathematical Optimization. Reviews of some mathematics for linear programming, in particular, linear algebras.
Mathematical Programming Models	4	Representative mathematical programming models such as linear programming models, network programming models, noninear programming models, and combinatorial programming models, with simple illustrative examples.
Linear Programming and Basic Solutions	2	Formulation of linear programs in the standard form, and basic concepts of basic solutions, basic feasible solutions, and optimal basic solutions.
Simplex Method	3	Basic ideas and concrete procedures of the simplex method that is a classical method for linear programming. Topics include two-stage linear programming, variables with upper bounds, and network simplex methods.
Duality and Sensitivity Analysis	3	Duality as an important theory in linear programming, and sensitivity analysis as a useful technique in decision making.
Interior Point Methods	1	Interior point methods as polynomial-time algorithms in linear programming.
Review and Summary	1	Review and Summary. Confirmation of achievement level.

【Textbook】Fukushima, M.: Introduction to Mathematical Programming: New Edition (in Japanese), Asakura Shoten .

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91240

Introduction to Programming

プログラミング入門

【Code】91240 【Course Year】1st year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	2-3	
	2-3	
	2-3	
	2-3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

20500

Applied Mathematics A1

工業数学 A1

【Code】20500 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】mitsuru shibayama

【Course Description】Complex analysis.

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises are taken into account when needed.

【Course Goals】To understand properties of complex functions with a skill for evaluation of integrals appearing in applied mathematics and physics.

【Course Topics】

Theme	Class number of times	Description
Complex numbers and the complex plane	2	Complex numbers and the complex plane are introduced.
Complex functions and the regularity	3	Complex functions are introduced and the regularity of complex functions are explained.
Contour integrals of analytic functions	3	Contour integral of analytic functions are stated. Cauchy's theorem and formula are explained.
Laurent series and the residue theorem	3	Laurent expansion that is power series around isolated singularities is explained. The calculus of residues and the residue theorem are also explained.
Integral calculations	3	Some integral calculations using Cauchy's theorem and the residue theorem are shown.
Feedback	1	After the final exam, answers is open. Students study it themselves.

【Textbook】

【Textbook(supplemental)】Y. Iso, Introduction to complex functions, SAIENSU-SHA (Japanese)

【Prerequisite(s)】Calculus, Linear algebra

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【Web Sites】KULASIS

【Additional Information】

91250

Applied Mathematics and Physics Laboratory

数理工学実験

【Code】91250 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】4

【Restriction】As a general rule, participation in the guidance class is a condition for taking this course. If you can not participate due to unavoidable circumstances such as illness, promptly contact the experiment representative or the education matters office.

【Lecture Form(s)】 【Language】Japanese 【Instructor】

【Course Description】Applied mathematics and physics as an academic discipline gives a theoretical interpretation and explanation to the behavior and physical phenomena of various systems around us, and provides a means of problem solving. For the purpose of acquiring the fundamental skills and methods of applied mathematics and physics, we will tackle several experiment themes prepared from fields such as operations research and communication network.

【Grading】Evaluation will be based on class attendance and a report for each of the class themes. The minimum passing criterion is attendance to all class sessions and submitted reports for each theme, however this does not guarantee a passing mark and obtained credit. Late arrivals, absence and report re-submission will influence negatively on the final evaluation score.

【Course Goals】Acquire an understanding of fundamental algorithms in the fields of operations research and communication networks, as well as acquire basic programming techniques for implementing such algorithms, perform experiments, and analyze experiment data to draw conclusions and insights.

【Course Topics】

Theme	Class number of times	Description
Guidance	1	Explanation of experiment guideline. Explanation about the BYOD (Bring Your Own Device) system will be given, so please bring your PC at the guidance.
Continuous Optimization	9	Given an objective function and some constraints that take a vector as an argument, we call the problem of finding a value for the argument vector that minimizes (or maximizes) the value of the objective function under the given constrains an “Optimization Problem”. In this experiment, students will implement a procedure that generates a sequence of points that converge to an optimal solution (called an iterative method) of a given optimization problem. Further, the students should observe and discuss the appropriateness of a solution delivered by their implementation, as well as the time needed to reach to this solution.
Discrete Optimization	9	Combinatorial, or Discrete, optimization problems are optimization problems where the feasible solution space is discrete, and can be defined by some combinatorial structures such as orders or partitions. These types of problems often occur in many areas, but it is difficult to solve them efficiently unless one grasps the structure of the problem. In this experiment, students will get familiar with the difficulty of combinatorial optimization problems through some representative problems, such as the Subset Sum or Shortest Path problems. Further, will study and implement the method of Dynamic Programming as one of the solution methods for combinatorial optimization problems.
Communication Network Design	9	As an application example of queuing theory, consider designing a communication network. Through two simple case studies, students will explore the differences between the design methods of a voice network and a data network. Further, students will learn how to use queuing theory to evaluate the performance of a network as a design indicator. As an assignment, students will also tackle the design of an optimal network under given constraints.
Confirmation of Learning Achievements	2	Provide feedback to students on basic topics such as report-writing or the contents of the course.

【Textbook】An experiment manual prepared by the instructors will be distributed in class.

【Textbook(supplemental)】Supplemental materials will be introduced if deemed necessary.

【Prerequisite(s)】Acquired credits for all Basic Subjects offered by the Applied Mathematics and Physics Course.

【】Pre-class preparation by reading the provided experiment manual, class notes, and other reference materials is highly recommended.

【Web Sites】

【Additional Information】It is mandatory to attend the guidance at the first class in October.

Details of the guidance time and place will be announced in September on the notice board in front of the administration office in General Research Building 8.

At the guidance, explanation about the BYOD (Bring Your Own Device) system will be given, so please bring your PC at the guidance.

90890

Applied Mathematics and Physics Laboratory

数理工学実験

【Code】90890 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】As a general rule, participation in the guidance class is a condition for taking this course. If you can not participate due to unavoidable circumstances such as illness, promptly contact the experiment representative or the education matters office.

【Lecture Form(s)】 【Language】Japanese 【Instructor】

【Course Description】Applied mathematics and physics as an academic discipline gives a theoretical interpretation and explanation to the behavior and physical phenomena of various systems around us, and provides a means of problem solving. For the purpose of acquiring the fundamental skills and methods of applied mathematics and physics, we will tackle several experiment themes prepared from fields such as operations research and communication network.

【Grading】Evaluation will be based on class attendance and a report for each of the class themes. The minimum passing criterion is attendance to all class sessions and submitted reports for each theme, however this does not guarantee a passing mark and obtained credit. Late arrivals, absence and report re-submission will influence negatively on the final evaluation score.

【Course Goals】Acquire an understanding of fundamental algorithms in the fields of operations research and communication networks, as well as acquire basic programming techniques for implementing such algorithms, perform experiments, and analyze experiment data to draw conclusions and insights.

【Course Topics】

Theme	Class number of times	Description
Guidance	1	Explanation of experiment guideline.
Continuous Optimization	9	Given an objective function and some constraints that take a vector as an argument, we call the problem of finding a value for the argument vector that minimizes (or maximizes) the value of the objective function under the given constrains an “Optimization Problem”. In this experiment, students will implement a procedure that generates a sequence of points that converge to an optimal solution (called an iterative method) of a given optimization problem. Further, the students should observe and discuss the appropriateness of a solution delivered by their implementation, as well as the time needed to reach to this solution.
Discrete Optimization	9	Combinatorial, or Discrete, optimization problems are optimization problems where the feasible solution space is discrete, and can be defined by some combinatorial structures such as orders or partitions. These types of problems often occur in many areas, but it is difficult to solve them efficiently unless one grasps the structure of the problem. In this experiment, students will get familiar with the difficulty of combinatorial optimization problems through some representative problems, such as the Subset Sum or Shortest Path problems. Further, will study and implement the method of Dynamic Programming as one of the solution methods for combinatorial optimization problems.
Communication Network Design	9	As an application example of queuing theory, consider designing a communication network. Through two simple case studies, students will explore the differences between the design methods of a voice network and a data network. Further, students will learn how to use queuing theory to evaluate the performance of a network as a design indicator. As an assignment, students will also tackle the design of an optimal network under given constraints.
Confirmation of Learning Achievements	2	Provide feedback to students on basic topics such as report-writing or the contents of the course.

【Textbook】An experiment manual prepared by the instructors will be distributed in class.

【Textbook(supplemental)】Supplemental materials will be introduced if deemed necessary.

【Prerequisite(s)】Acquired credits for all Basic Subjects offered by the Applied Mathematics and Physics Course.

【】Pre-class preparation by reading the provided experiment manual, class notes, and other reference materials is highly recommended.

【Web Sites】

【Additional Information】The number of credits that students can obtain through this course has changed for students who have entered as of 2008.

It is mandatory to attend the guidance at the first class in October.

Details of the guidance time and place will be announced in September on the notice board in front of the administration office in General Research Building 8.

At the guidance, explanation about the BYOD (Bring Your Own Device) system will be given, so please bring your PC at the guidance.

90900

Exercise on Applied Mathematics and Physics

基礎数理演習

【Code】90900 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90910

Exercise on Programming

プログラミング演習

【Code】90910 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】Exercise on C programming. This class is mainly designed for beginners of programming. Students will practice the fundamental syntax of C language, such as data types, operators, conditional statements, loops, arrays, strings, pointers, functions, structures, file I/O, etc. Further, they will study the computer simulation method as one of application exercises. Besides the exercises in the class, the“Program Contest of the Applied Mathematics and Physics Course (may not be held depending on circumstances)”(arbitrary participation) will be introduced and explained to have a chance to challenge more advanced programming.

【Grading】Evaluation will be based on submitted programs (source codes) for 70% and a report for 30%. Class attendance will be emphasized, and late arrival, absence and early leave will influence negatively on the final evaluation score.

【Course Goals】Acquire the knowledge and skills of programming to be able to make a program (or source code) as one wants when seeking a solution in any field of the applied mathematics and physics by computer programming.

【Course Topics】

Theme	Class number of times	Description
Guidance	1	Explanation of exercise guideline and how to progress with programming.
Fundamentals of C	9	Practice of C syntax from data types to file I/O through the textbook.
Simulation Method	2	How to make simulation programs by using random number generators, Monte Carlo method, Runge-Kutta method, etc.
Program Contest	2	Explanation of this year’s contest theme and its introductory exercise.
Confirmation of Learning Achievements	1	Confirm the achieving level of programming ability.

【Textbook】「やさしく学べる C 言語入門［第 2 版］」（皆本晃弥著，サイエンス社，2015）

【Textbook(supplemental)】None

【Prerequisite(s)】None

【】Students will be asked to prepare specified pages of the textbook every time.

【Web Sites】URL: Program Contest of the Applied Mathematics and Physics Course
http://infosys.sys.i.kyoto-u.ac.jp/~contest/

【Additional Information】The attendance of guidance is requisite for taking this class. Each student is required to have obtained an ECS-ID (account for the education computer system) and the textbook by the start of the class.

91300

Introduction to Electric and Electronic Circuit Theory

電気電子回路入門

【Code】91300 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1.5	
	3.5	
	2	
	4	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91310

Mathematics in Practice for Computer Science

計算機科学のための数学演習

【Code】91310 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91380

Hardware and Software Laboratory Project 1

計算機科学実験及演習 1

【Code】91380 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	5	
	5	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90210

Hardware and Software Laboratory Project 1

計算機科学実験及演習 1

【Code】90210 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】1

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90220

Hardware and Software Laboratory Project 2

計算機科学実験及演習 2

【Code】90220 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	7	
	7	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90070

Introduction to Systems Analysis

システム解析入門

【Code】90070【Course Year】2nd year【Term】【Class day & Period】【Location】Integrated Research Bldg.-213

【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Yoshito Ohta, Professor

【Course Description】We will start by showing some examples of dyanamical systems in engineering. Then we mention modelling and analysis techniques. We explain Electrical circuits and mechanical systems that use the linearizaton technique in detail. Throughout the course, we aim to understand the importance of dynamical system modeling and the implication of system control based on mathematical models.

【Grading】The grade is determined by the final examination.

【Course Goals】We will learn examples of dynamical systems and the rudiments of dynamical systems and approximated linearized systems. This course will be the basics of Linear Control Theory (90720) and Modern Control Theory (90580).

【Course Topics】

Theme	Class number of times	Description
Introduction to system analysis	2	Overview of the course.
Linear dynamical systems	3	First and second order systems such as electric circuits consisting of a capacitor and an inductor and mechanical systems consisting of a spring and a dumper.
State equation and linear approximation	1	Linearized systems at an operating point. Linear dynamical systems and their responses.
Laplace transform and transfer function	2	Laplace transform and linear differential equations. Transfer functions of first and second order systems.
Examples of system modeling	2	Examples of system modeling including mechanical systems, biological systems, and social infrastructures.
Discrete-time systems	1	Discrete-time systems described by difference equations.
System identification	1	System modeling using input-output data.
Exercises	3	Excercises.

【Textbook】Handouts are given.

【Textbook(supplemental)】Shimemura, What is automatic control?, Korona (in Japanese)

【Prerequisite(s)】Linear Algebra (A and B) and Calculus (A and B) are recommended.

【】Read the handouts in advance. Solve problems in the houdouts and exercise problems.

【Web Sites】http://www.bode.amp.i.kyoto-u.ac.jp/member/yoshito_ohta/system/index.html

【Additional Information】Contact the instructor using email. Address: yoshito_ohta@i.kyoto-u.ac.jp

90701

Logical Systems
論理システム

【Code】90701 【Course Year】 【Term】 【Class day & Period】 【Location】Integrated Research Bldg.-111

【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	6	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90710

Analytical Dynamics

解析力学

【Code】90710 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	7	
	8	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90700

Logical Systems

論理システム

【Code】90700 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Graduate School of Informatics, Professor, Naofumi Takagi

【Course Description】We learn mathematical logic and logic algebra which are bases of computer science, and logic circuits which are bases of digital systems such as computers. First, we learn mathematical logic especially propositional logic. Then, we learn logic algebra and logic functions, and how to minimize logic functions. We also learn combinational logic circuits and sequential circuits.

【Grading】Grading is done through a term-end examination (95%) and exercises (5%) on the course goals.

【Course Goals】1. Understanding propositional logic and being able to explain it. 2. Understanding basic concepts in logic algebra and logic function, and being able to explain them. 3. Understanding the minimization methods of logic functions, and being able to use them. 4. Understanding basic concepts in combinational circuits and sequential circuits and design methods of them, and being able to explain them.

【Course Topics】

Theme	Class number of times	Description
Mathematical logic	2	Sets, relations, etc. Introduction to mathematical logic and propositional logic.
Logic algebra and logic function	2	Logic algebra, logic expression, logic function and its representation
Minimization of logic functions	2	Minimization of logic functions
Special logic functions	2	Logic functions with special characteristics
Combinational circuits	2	Design and analysis of combinational circuits
Sequential machines and sequential circuits	4	Sequential circuits and their design methods, especially minimization methods of sequential machines and state assignment.
Term-end examination	1	
Feedback	1	

【Textbook】Logic circuits, by Naofumi Takagi, Ohm-sha

【Textbook(supplemental)】

【Prerequisite(s)】

【】Students are required to prepare for each classroom.

Students are required to solve exercises give at each classroom and to submit answers at the next clasroom.

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/ls.html

【Additional Information】Office hour: Tuesday, 16:30-17:30

Office: Rm. 330, Research Building #7

Email:takagi@i.kyoto-u.ac.jp

91040

Languages and Automata

言語・オートマトン

【Code】91040 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】We start with regular expressions and finite automata, then go to context-free grammars and pushdown automata. We learn why studying automata theory is important in computer science especially design and analysis of algorithms.

【Grading】Will be specified in the lectures.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
Finite automata	5	Description of finite automata, minimization and regular expressions.
Context-free grammars	4	Push-down automata, context-free grammars and their equivalency.
Turing machines and related issues	3	Turing machine, its definition and basic properties.
Hierarchy of languages	2	Summary of language classes. Discussions to check the achievements of students

【Textbook】Iwama, Automata, languages and theory of computation, Corona-sha, 2003 .

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91270

Computer organization

計算機の構成

【Code】91270 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Graduate School of Informatics, Professor, Naofumi Takagi

【Course Description】We learn basic organization of computers, instructions of computers, and computer arithmetic. We also learn how to design simple computers and overview of memory hierarchy and I/O of computers.

【Grading】Grading is done through a term-end examination (about 95%) and exercises (about 5%) on the course goals.

【Course Goals】1. Understanding basic organization of a computer, and being able to explain it.
2. Understanding instructions of computers, and being able to explain them.
3. Understanding computer arithmetic, and being able to explain it. 4. Understanding design methods of simple processors, and being able to use them.
5. Understanding overview of memory hierarchy and I/O of computers, and being able to explain them.

【Course Topics】

Theme	Class number of times	Description
Basic organization of a computer	2	Basic organization of a computer
Instractions of computers	5	Instractions of computers
Computer arithmetic	3	Computer arithmetic, floating-point operations
Design of simple processors	3	Design methods of simple processors
Overview of memory hierarchy and I/O	1	Overview of memory hierarchy and I/O
Term-end examination	1	
Fedback	1	

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 5th ed. No. 1
by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP

【Textbook(supplemental)】

【Prerequisite(s)】Having knowledge on logic systems is preferable.

【】Students are required to prepare for each classroom.
Students are required to solve exercises given at each classroom and to submit answers at the next classroom.

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/co.html

【Additional Information】Office hour: Tuesday, 16:30-17:30
Office: Rm. 330, Research Building #7
Email:takagi@i.kyoto-u.ac.jp

90170

Programming Languages

プログラミング言語

【Code】90170 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	4	
	2	
	2	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91280

Implementation of Programming Languages

プログラミング言語処理系

【Code】91280 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Kohei Suenaga

【Course Description】This class will be given in Japanese. For the detail of the class, see the Japanese version.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Programming language used in the class	1	
Interpreters	5	
Midterm exam	1	
Backend of compilers	3	
Lexers and parsers	3	
Advanced topics	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91290

Information and Coding Theory

情報符号理論

【Code】91290 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Prof. Toyoaki Nishida, Graduate School of Informatics

【Course Description】This course introduces information theory, an foundation for reliable information transmission and storage. We elaborate on source and channel models, source and channel coding, quantitative measure of information and entropy, and coding theory.

【Grading】Credit will be awarded based on a final written examination and one or more mini-tests.

【Course Goals】Students will be able to understand and apply basic concepts and principles of information theory.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	I briefly overview the history, goal, techniques and applications of information theory.
Source Coding and its Limitation	5	I introduce source coding, Markov sources, the source coding theorem, and entropy of information source.
Channel Coding and its Limitation	4	I elaborate on mutual information and entropy, channel capacity, maximum likelihood decoding, random coding, and the channel coding theorem.
Coding Theory	4	Following a general introduction to coding theory, I describe parity codes, Hamming codes, cyclic codes, and BCH codes.
Feedback	1	I will answer questions arising from the lecture and advise on further learning.

【Textbook】Hideki Imai: Information Theory, Shokodo (in Japanese)

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91090

Computer Networks

コンピュータネットワーク

【Code】91090 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Learn about basic technologies on computer networks, which are the indispensable basis of the ubiquitous network society. The idea of the Internet, basic concepts of the Internet architecture and the protocols are lectured. Visions for the future are also presented.

【Grading】Grading is based on the semester-end exam, and partially on reports and the attendance.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	2	- Service and protocols - The reference models
The Application Layer	3	- The application layer and principles - The transport service - Application-level protocols * The Domain Name System * Electronic mail * The Hyper Text Transfer Protocol - Writing simple networked applications
The Transport Layer	3	- Principles of a reliable transport protocol - The User Datagram Protocol (UDP) - The Transmission Control Protocol (TCP)
The Network Layer	3	- Principles * Datagram and virtual circuit * routing - Internet Protocol (IP) - Routing in IP networks
The Datalink Layer and the Local Area Networks	2	- Principles - Media Access Control - Datalink layer technologies
Network Security	1	- Information security and network security - Cyber laws

【Textbook】Olivier Bonaventure 著： Computer Networking : Principles, Protocols and Practice, 1st edition
http://cnp3book.info.ucl.ac.be/1st/html/

【Textbook(supplemental)】Norio Shiratori (ed.): Information Network (Kyoritsu)
Katsuo Ikeda (ed.): Computer networks (Ohmsha)

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

90300

Graph Theory
グラフ理論

【Code】90300 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】We learn basic theories of graphs and their applications, and fundamental algorithms for solving graph problems.

【Grading】Mainly evaluated by the final exam. In some cases, exercises, discussions in class, and the number of attendance to the class may be considered.

【Course Goals】The goal of this course is to learn basic theories of graphs and their applications, and fundamental algorithms for solving graph problems.

【Course Topics】

Theme	Class number of times	Description
Graphs and algorithms	4	I explain definition of graphs and basic properties of graphs. I also briefly review the basics of algorithms and their complexity.
Minimum spanning trees	1	Kruskal's algorithm, Prim's algorithm, Steiner tree problem.
Shortest path problems	1	Dijkstra's algorithm
Eurer circuits and Hamiltonian cycles	2	Eurer circuits, Hamiltonian cycles, Dirac's theorem. Ore's theorem.
Graph coloring	2	Vertex coloring, and edge coloring. Brooks's theorem, Vizing's theorem, Konig's theorem. Coloring maps.
Maximum flow problems	2	Ford-Fulkerson's algorithm.
Matching	2	Matchings, in particular, bipartite matchings. Hall's theorem, Hungarian method.
Exam	1	

【Textbook】グラフ理論入門 ～基本とアルゴリズム～ , 宮崎修一，森北出版株式会社 (in Japanese)

【Textbook(supplemental)】I show some recommended books in class.

【Prerequisite(s)】Basics of algorithms, data structures, and set theory.

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【Web Sites】

【Additional Information】

90301

Graph Theory
グラフ理論

【Code】90301 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】
【Course Description】After basic notations and properties on graphs and networks are given, algorithms to some representative problems such as the shortest path problem, the minimum spanning tree problem and the maximum flow problem are described. Applications of these results and extensions of them in discrete mathematics are also presented.
【Grading】Evaluation is made based on marks on answers in exercises (30%) and score of end-term examination (70%)
【Course Goals】Not only to learn the notions on graph structure as knowledge but to understand proofs to mathematical properties on discrete structures and logical mechanisms in computational methods
【Course Topics】

Theme	Class number of times	Description
graphs and networks	1	Basic terminology on graphs and networks are defined, and some representative problems such as the Eulerian trail problem, the Hamiltonian cycle problem and the graph isomorphism problem are introduced.
connectivity	1	Graph connectivity such as k-connectivity of undirected graphs and strong connectivity of digraphs are defined and some properties for them are derived.
plane graphs and dual graphs	2	Some combinatorial aspects of graphs such as Kratowski's theorem, which characterizes the planar graphs, duality of plane graphs, the four-color theorem are described.
representation for graphs	1	As representation for data to input graphs, matrix and adjacency lists are introduced.
graph search	2	The depth first search and the width first search are introduced, and as their applications, an algorithm for computing cut-vertices and biconnected components is designed.
shortest path	2	Properties on shortest paths and Dijkstra's method, as a representative shortest path algorithm, are described.
trees and cut-sets	1	Important properties on spanning trees and cut-sets, especially the roles of fundamental cycles and fundamental cut-sets are described.
minimum spanning tree	1-2	Kruskal's method and Prim's method, as representative minimum spanning tree algorithms, are described, and data structure for them and their computational complexities are discussed.
maximum-flow	2	The maximum-flow and minimum-cut theorem in networks and an algorithm for finding a maximum flow are described.

【Textbook】
【Textbook(supplemental)】C ni yoru Algorithms to Data Structure, Ibaraki, Shokou-do
【Prerequisite(s)】
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【Web Sites】Necessary materials are uploaded at http://www-or.amp.i.kyoto-u.ac.jp/members/nag/
【Additional Information】Some exercises are conducted in each class. The answers to questions in exercises and end-term examination and the achievement attained by students to each question will be uploaded.

90250

Numerical Analysis

数値解析

【Code】90250 【Course Year】【Term】【Class day & Period】【Location】Engineering Science Depts Bldg.-313

【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	6	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

20600

Applied Mathematics A2

工業数学 A2

【Code】20600 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Nakamura Yoshimasa, Tsujimoto Satoshi

【Course Description】"Numerical Analysis" is prerequisite to this course. In this course matrix eigenvalue problem and singular value decomposition, iteration methods for nonlinear equations, interpolation methods by polynomials, and numerical integration methods are explained which are important especially in data science and information processing. *There is a possibility to replace Course Topics. Detail will be announced at the first class.

【Grading】mainly evaluated by examination score, but reports of exercises will be taken into account in a case.

【Course Goals】Understanding both the theory and practical methods for applications through general-purpose softwares and/or programs by each student is a goal of this course.

【Course Topics】

Theme	Class number of times	Description
matrix eigenvalue problem	6	computation of matrix eigenvalues and eigenvectors by the Jacobi method, Gershgorin theorem, the power method and the inverse iteration, the QR method and the divide & conquer method with the Householder transformations for preprocessing, Sturm theorem
matrix singular value decomposition	1	computation of matrix singular value decomposition
iterative methods for nonlinear equations	3	the principle of contractive mapping and the Newton method both of one and multi variables, and convergence acceleration algorithms
interpolation methods	2	the Lagrange interpolation formula and the Hermitian interpolation formula by polynomials, and the spline functions
numerical integration methods	2	Newton-Cotes numerical integration formula,and the Gauss type numerical integration formula
confirmation for student assessment	1	confirmation for each student assessment
	1	

【Textbook】"Introduction of Numerical Analysis" (in Japanese) by T. Yamamoto, SAIENSU-SHA

【Textbook(supplemental)】

【Prerequisite(s)】Linear Algebra A, Linear Algebra B, Numerical Analysis

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【Web Sites】

【Additional Information】

20700

Applied Mathematics A3

工業数学 A3

【Code】20700 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Fourier analysis originated in Fourier's work on thermal conduction and now becomes very important not only in mathematics but also in engineering, including applications in measurement technology. This course provides its theories and applications along with Laplace analysis closely related to it.

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises and homework are taken into account when needed.

【Course Goals】To understand the fundamental theories of Fourier and Laplace analysis and develop an ability to apply them to concrete problems.

【Course Topics】

Theme	Class number of times	Description
Fourier series	2-3	The definition of Fourier series expansions are given and their fundamental properties such as computation of Fourier coefficients and convergence of Fourier series are discussed.
Properties and applications of Fourier series	3-4	Several properties of Fourier series and their applications to differential and difference equations and signal processing are discussed.
One-dimensional Fourier transform	3-4	The definition of one-dimensional Fourier transforms is given, and their fundamental properties such as the inversion formula and applications to partial differential equations are discussed.
Multi-dimensional Fourier transform	2-3	The definition of multi-dimensional Fourier transforms is given, and their fundamental properties and applications to partial differential equations are discussed.
Laplace transforms	2-3	Properties of Laplace transforms and their applications to differential equations are discussed.
Summary and learning achievement evaluation	1	A summary and supplements of this course are given and the learning achievement of students is evaluated.

【Textbook】S. Nakamura: Fourier analysis, Asakura shoten

【Textbook(supplemental)】H.Fukawa: Mathematics of control and vibration, KORONA-SHA

【Prerequisite(s)】Calculus, Linear Algebra and Differential Eqautions

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【Web Sites】

【Additional Information】

90800

Mathematics of Dynamical Systems

力学系の数学

【Code】90800 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Dynamical systems represent general mathematical models such as differential equations for time-dependent phenomena and a mathematical field having originated in the work of the greatest mathematician in 19th century, Poincare. Dynamical systems theory provides tools to treat nonlinear phenomena such as bifurcations and chaos, and its application range is very wide since there are numerous time-dependent phenomena in natural and social sciences. This course provides fundamentals of dynamical systems theory with a special focus on differential equations.

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises and homework are taken into account when needed.

【Course Goals】(1) To understand dynamics of differential equations and maps near neighborhoods of equilibria and fixed points
(2) To understand mechanisms for nonlinear phenomena such as bifurcations and chaos
(3) To master fundamental techniques for dynamical systems

【Course Topics】

Theme	Class number of times	Description
Introduction to Dynamical Systems	5-6	Fundamentals of differential equations are reviewed and elementary concepts such as Poincare maps, stability, dynamics of linear systems and invariant manifolds are explained.
Local Bifurcations	4-5	Bifurcations of equilibria and fixed points, center manifold reductions and normal forms are discussed.
Chaos	4-5	Horseshoe maps, homoclinic theorem and Melnikov's method are discussed.

【Textbook】Handouts

【Textbook(supplemental)】K.T. Alligood, T. Sauer and J.A. Yorke, Chaos: An Introduction to Dynamical Systems, Springer
M.W. Hirsch, S. Smale and R.L. Devaney,Differential Equations, Dynamical Systems, and an Introduction to Chaos
J. Guckenheimer and P. Holmes, Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields, Springer
J.D. Meiss, Differential Dynamical Systems, SIAM
S. Wiggins, Introduction to Applied Nonlinear Dynamical Systems and Chaos, Springer

【Prerequisite(s)】Calculus, Linear Algebra and Differential Equations

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【Web Sites】

【Additional Information】

90720

Linear Control Theory

線形制御理論

【Code】90720 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】In this course, we will learn the basics of feedback control theory which has wide range of applications such as drones, automatic driving, systems biology. We will give lectures on analysis of feedback systems, stability criterion, servo mechanism design, and so on, based on Laplace transform.

【Grading】The final grade in this course is based on your scores in reports and the final examination.

【Course Goals】The goal of this course is to understand the basics on analysis of feedback systems and to acquire frequency-domain methods for control systems design.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Laplace transform	2	
System modeling and transfer function	2	
Transient response and stability	3	
Frequency response	2	
Stability analysis of feedback systems	2	
Characteristics of feedback control systems	2	
Summary	1	

【Textbook】None.

【Textbook(supplemental)】T. Sugie and M. Fujita: Introduction to Feedback Control (in Japanese). Corona Publishing, 1999
T. Katayama: Fundamentals of Feedback Control: New edition (in Japanese). Asakura Publisher, 2002

【Prerequisite(s)】It is recommended, but not required, that students take Introduction to Systems Analysis (90070) and Applied Mathematics A3 (20700) before taking this course.

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【Web Sites】

【Additional Information】

90280

Probability and Statistics

確率と統計

【Code】90280 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This course involves the basics of probability and statistics. The probability theory is illustrated through random number generation. Theory and applications of statistical inference, such as Bayesian inference and maximum likelihood method, are then discussed.

【Grading】Grading is based on papers and final exam.

【Course Goals】To understand the basics of probability and statistics from the viewpoints of mathematics, algorithm, and applications.

【Course Topics】

Theme	Class number of times	Description
Monte Carlo methods	6	Random number generation from probability distribution: inverse transform sampling, rejection sampling, Markov chain Monte Carlo (Metropolis-Hastings sampler, Gibbs sampler). Simulation of the model of ferromagnetism. The basics of probability (probability distribution, density function, the law of large numbers, the central limit theorem).
Bayesian inference	4	Statistical inference with Bayes method. Image restoration via Bayesian inference with Markov chain Monte Carlo. Classification via Bayesian discriminant analysis with an application to spam mail filter. The error rate of Bayes classifier.
The methods of least squares and maximum likelihood	5	Theory of statistical inference including the following topics. Multiple regression analysis with least squares and weighted least squares. Logistic regression analysis via maximum likelihood method. The asymptotic distribution of the maximum likelihood estimator (MLE). Hypothesis testing and model selection. Additional topics including multivariate analysis (principal component analysis, canonical correlation analysis).

【Textbook】Handouts may be distributed in class.

【Textbook(supplemental)】C. M. Bishop: Pattern Recognition and Machine Learning, Springer.
T. Hastie, R. Tibshirani, and J. Friedman: The Elements of Statistical Learning, Springer.

【Prerequisite(s)】

【】In addition to attending class, work at home including real data analysis is required.

【Web Sites】

【Additional Information】Details of office hours will be notified at class.

90960

Stochastic Discrete Event Systems

確率離散事象論

【Code】90960 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】In the analysis of stochastic discrete event systems, the theoretical results on Markov chains are useful mathematical tools. This course covers the fundamental results of Markov chains and their applications to ranking/rating methods and to the analysis methods of basic queuing models.

【Grading】Based on the scores of the term examination.

【Course Goals】This course aims to deepen the understanding of the fundamental results of Markov chains and their applications.

【Course Topics】

Theme	Class number of times	Description
Outline of this course and review of fundamental notions	1 ～ 2	The contents of this course are outlined. Furthermore, basic notions, such as random variables, probability distributions and generating function methods, are explained.
Discrete-time Markov chains	3 ～ 4	The discrete-time Markov chain is introduced. Topics include the basic notions of the Markov chain, such as irreducibility, period, and recurrence, as well as the condition for the existence of its stationary and limiting distributions.
Markov methods for ranking/rating	2 ～ 3	Markov methods for ranking/rating are lectured, focusing on the group of web pages.
Continuous-time Markov chains	3 ～ 4	The Poisson process and continuous-time Markov chain are introduced. Furthermore, the properties of a birth-and-death process (a special case of the continuous-time Markov chain) are explained, together with the derivation of its stationary distribution.
Exponential-type queueing models	2 ～ 3	Exponential-type queueing models (which are reduced to birth-and-death processes) are lectured, focusing on the derivation of their performance measures, such as the stationary queue length distribution and the waiting time distribution.

【Textbook】Handouts are provided.

【Textbook(supplemental)】P. Bremaud, Markov Chains: Gibbs Fields, Monte Carlo Simulation, and Queues, Springer, 1999.
L. Kleinrock, Queueing Systems Vol.1, John Wiley and Sons, 1975.

【Prerequisite(s)】Background knowledge on probability and statistics is helpful to learn this course but it is not prerequisite.

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【Web Sites】

【Additional Information】

90310

Applied Algebra

応用代数学

【Code】90310 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】An introduction with application to basic algebra in informatics.

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises are taken into account when needed.

【Course Goals】To understand basic ideas and some applications of algebras (mainly group theory).

【Course Topics】

Theme	Class number of times	Description
Introduction to group theory	2-3	Definition and examples of group: symmetric group, permutation group, cyclic group, general linear group and so on.
Structure of groups	4-5	Subgroup, coset, normal subgroup, quotient group, the isomorphism theorems.
Symmetric group and enumeration problem	3-4	Action of the symmetric group on a finite set. Enumeration problem.
Group representation	3-4	Groups in terms of linear transformations of vector space.
Summary and assessment	1	Summary and supplement of this course. Measure the progress of students in acquiring knowledge and skills.

【Textbook】

【Textbook(supplemental)】T. Hiramatsu: Joho no suri oyo daisugaku (Shokabo)

【Prerequisite(s)】Linear algebra

【】

【Web Sites】http://www-is.amp.i.kyoto-u.ac.jp/lab/tujimoto/appalg/

【Additional Information】

91160

Artificial Intelligence

人工知能

【Code】91160 【Course Year】3rd year 【Term】 【Class day & Period】

【Location】Engineering Science Depts Bldg.-313 【Credits】2 【Restriction】No Restriction

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This lecture introduces basic technologies of artificial intelligence. Topics will be selected from search, machine learning, and real-world agent.

【Grading】By reports and a final examination.

【Course Goals】Learning the concept of artificial intelligence and the basic models and algorithms of search, machine learning, and real-world agent.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Introducing the history of artificial intelligence researches.
Search	3-4	Introducing breadth-first search, depth-first search, heuristic search, AND/OR-graph search, adversarial search, constraint satisfaction, etc. Applications of search techniques such as computer chess, Sudoku, are also introduced.
Machine Learning	7-8	Introducing decision tree learning, perceptron, SVM, genetic algorithm, reinforcement learning, deep learning, etc. Applications of machine learning techniques such as data mining are also introduced.
Real-world agent	3-4	Introducing AI techniques for "uncertain" situation, including basic perception and robotics, and probabilistic reasoning over time. Applications of AI for robotics are also introduced.
Achievement level check	1	Checking the achievement level

【Textbook】Materials will be distributed.

【Textbook(supplemental)】S. Russell and P. Norvig, Artificial Intelligence A Modern Approach (3rd.ed.), Prentice Hall, 2010 .

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

91170

Human Interface

ヒューマンインタフェース

【Code】91170 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This lecture introduces basic concepts and methods of interaction design. Topics will be selected from user model, usability analysis, experiment and evaluation, and design process.

【Grading】By reports and a final examination.

【Course Goals】Learning the concepts and methods of interaction design, including user model, usability analysis, experiment and evaluation, and design process.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Introducing the history and important concepts of interaction design.
Usability analysis	2-3	Introducing usability analysis and evaluation methods including questionnaire, interview, heuristic evaluation and cognitive walkthrough. Applications of usability analysis to Web evaluation are also introduced.
Experiments and evaluation	3-4	Introducing various evaluation methods including ethnography and statistical analysis. Applications of those methods to real problems are discussed.
Design process	1-2	Introducing the process of interaction design. The comparison between interaction design and software design is explained.
Interfaces	2-3	Introducing various interfaces that enable several kinds of interactions including social and emotional ones. Then future interfaces are discussed.
Data gathering and analysis	2-3	Introducing data gathering and analysis methods in the design and evaluation process of interfaces with several examples.
Achievement level check	1	Checking the achievement level.

【Textbook】Preece, Sharp, Rogers. Interaction Design. Wiley, 3rd edition, 2011.

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

90920

Exercise on Numerical Analysis

数値計算演習

【Code】90920 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】The participation in the guidance is mandatory. If you cannot participate in the guidance, please let staffs know in advance. BYOD.
【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】
【Course Description】The numerical approach with computers is useful when we solve several problems in informatics and applied mathematics. In this exercise, we will learn numerical methods through implementing computer codes, executing the programs, and interpreting results.
【Grading】The students MUST submit all the reports for four subjects. The score of each subject is 25 and the grading will be done based on the total scores of reports.
【Course Goals】We will learn fundamental techniques for numerical analysis with computers. Specifically, we aim at obtaining the following four techniques. (1) Understanding algorithm for numerical analysis, (2) Coding techniques (3) Methodology of data analysis, and (4) writing ability.
【Course Topics】

Theme	Class number of times	Description
Guidance	1	We will explain contents of exercises on numerical simulations and introduce staffs and teaching assistants. We will further explain how to use computers in the computer room and account.
How to write an effective report	1	We will study how to write an effective report.
Numerical differentiation and integration method	4	We will study the basic of numerical calculations and numerical integration methods. (a) Euler method, Runge-Kutta method (b) trapezoidal rule, Simpson's rule.
Monte Carlo method	6	We will study the basic of Monte Carlo method which is a statistical method for simulating complex systems. (a) Markov Chain Monte Carlo method.
Diffusion equation	8	We will study an explicit Euler method and Crank – Nicolson method for a one-dimensional diffusion equation and a reaction-diffusion equation.
Statistics and statistical tests	8	We will study fundamental methods which we need in data analysis. (a) Statistical hypothesis test, (b) Regression analysis.
Check for students' understanding	2	Based on reports, we will take supplementary lessons to understand contents of this exercise.

【Textbook】Not in particular. hand out.
【Textbook(supplemental)】[1]「SUCHI KEISAN NO JOSHIKI」（Author:Masao Iri and Yoritake Fujino, Kyoritsu）
【Prerequisite(s)】Under the UNIX operating system, students have to edit a file, code and test C programs, make reports and graphs, and print them. BYOD.
【】
【Web Sites】
【Additional Information】If you have any questions, please do not hesitate to ask them to teachers. Please make an appointment with a teacher corresponding to each subject.

90740

Seminar on Applied Mathematics and Physics

数理工学セミナー

【Code】90740 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】Having seminars on various themes related to applied mathematics and physics.

【Grading】Attendances are requested. Presentation and discussions are evaluated.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Seminars		Eight themes are provided.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】In early July, all the themes of seminars are announced. Students are asked to give application forms. It is assumed that students are looking at the announce board of the department office carefully.

91320

System Analysis Laboratory

システム工学実験

【Code】91320 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】4

【Restriction】It is necessary to attend the first guidance. The date and place of the guidance will be noticed on the bulletin board of the office by October.

【Lecture Form(s)】 【Language】Japanese 【Instructor】Kentaro OHKI, Kazuki NIINO, Yan LIU

【Course Description】Our course aims at learning (1) modeling, (2) analysis, and (3) control of systems through numerical computations and demonstrations on three subjects written in "Course Topics." Students will be divided into three groups and participate in all of the three subjects.

【Grading】Student's attendance and report for each subject are mainly evaluated. Besides, attitude and behavior as individuals and as a group of the student are also important for the evaluation.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Guidance	1	We will give introduction to this course and divide the participants into groups.
Active silencer	9	1. Introduction to principle of active sliencer 2. Basic lecture on DSP and programming 3. Experiment 4. Analyses on response in time and frequency We use specialized softwares, Scilab
Flexible-Link Manipulator	9	1. A recursive estimation of frequency transfer function and parameter identification 2. Tracking step signals 3. Two-degree-of-freedom controller 4. Tracking desired signals We use specialized software, Octave, MATLAB/SIMULINK.
Inverted Pendulum	9	1. Mechanical model of inverted pendulum and identification of its parameters 2. Controller by state space representation 3. Inference of state variables by observer 4. Pole-place method / optimal control method 5. Swinging up of inverted pendulum We use specialized software, Octave, MATLAB/SIMULINK

【Textbook】Each instructor will distribute his own text if it needs.

【Textbook(supplemental)】Doyle, Francis and Tannenbaum: Feedback Control Theory, Prentice Hall (1992)
Ljung: System Identification, 2nd edition, Prentice Hall (1998)

【Prerequisite(s)】A few subjects may be changed due to replacement of instructors.

【】

【Web Sites】

【Additional Information】We adhere the Kyoto University's BYOD policy. The students should bring your own device in order to write programs for any purpose.

90930

System Analysis Laboratory

システム工学実験

【Code】90930 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】

【Course Description】Our course aims at learning (1) modeling, (2) analysis, and (3) control of systems through numerical computations and demonstrations on three subjects written in "Course Topics." Students will be divided into three groups and participate in all of the three subjects.

【Grading】Student's attendance and report for each subject are mainly evaluated. Besides, attitude and behavior as individuals and as a group of the student are also important for the evaluation.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】Each instructor will distribute his own text if it needs.

【Textbook(supplemental)】Doyle, Francis and Tannenbaum: Feedback Control Theory, Prentice Hall (1992)
Ljung: System Identification, 2nd edition, Prentice Hall (1998)

【Prerequisite(s)】A few subjects may be changed due to replacement of instructors.

【】

【Web Sites】

【Additional Information】

90840

Hardware and Software Laboratory Project 3

計算機科学実験及演習 3

【Code】90840 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】4 【Restriction】

【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	15	
	15	
	15	
	15	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

90390

Hardware and Software Laboratory Project 4

計算機科学実験及演習４

【Code】90390 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】3

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	15	
	15	
	15	
	15	
	15	
	15	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90940

Physical Statistics

物理統計学

【Code】90940 【Course Year】3rd 【Term】2018・first semester 【Class day & Period】Tuesday・2

【Location】Faculty of Engineering Integrated Reseach Bldg. 102 【Credits】2 【Restriction】No Restriction

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Probability theory, statistical mechanics, and theory of stochastic processes are explained as methods to investigate systems with many degrees of freedom. Technics for describing dynamics, and fluctuation in equilibrium or stationary systems and some topics for nonequiliburium systems are explained.

【Grading】Based on quizzes and the semester final exam.

【Course Goals】To gain firmly the fundamental skills for understanding various phenomena with the use of probability theory and stochastic process.

【Course Topics】

Theme	Class number of times	Description
Fundamentals of probability and entropy	3	Continuous and discrete stochastic variables are introduced and entropy, KL entropy and mutual information are explained.
Fundamentals of statistical mechanics	3	Fundamentals of thermodynamics are reviewed and statistical mechanics is formularized with the maximum entropy principle. Applications to ideal gases and spin systems are explained.
Stochastic processes and random walks	3	Stochastic processes, especially Markov processes are explained. As examples, Gauss process, Poisson process, Wiener process and random walks are explained.
Langevin equaitons and Fokker-Planck equations	3	Brownian motion is introduced as an example of Langevin equations. Derivation of Fokker-Planck equations from Langevin equations are described and several applications of both equations are explained.
Some topics for nonequiliburium systems	2	We explain some topics chosen from entropy production in relaxation processes from nonequiliburium states to equilibrium states, the linear responce theory, the fluctuation theory, thermal excitation, diffusion and so on.

【Textbook】None

【Textbook(supplemental)】To be announced in the lecture

【Prerequisite(s)】Fundamentals of calculus and linear algebra

【】Reviews through solving the assigned quizzes are expected.

【Web Sites】

【Additional Information】According to progress of the lecture, some topics may be omitted or added.

90830

Mechanics of Continuous Media

連続体力学

【Code】90830 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】The lecture on fundamental theory of fluid dynamics and elasticity is given as an introduction to the theory of mechanical behavior of continuous media.

【Grading】Evaluation is based on the score of examination.

【Course Goals】Understanding the basic concepts in fluid dynamics and elasticity.

【Course Topics】

Theme	Class number of times	Description
concept of continuous media	1	
stress	2	
momentum equation	1	
basic equations of fluids	2-3	
dynamics of viscous fluids	3-4	
dynamics of inviscid fluids	1-2	
compressible fluids and sound waves	1	
basic equations in elasticity	2-3	

【Textbook】No

【Textbook(supplemental)】Introduced in the lecture

【Prerequisite(s)】analysis, linear algebra, fundamentals of dynamics, fundamentals of vector analysis

【】

【Web Sites】

【Additional Information】

90580

Modern Control Theory

現代制御論

【Code】90580 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This course provides the fundamentals in modern control theory - centered around the so-called state space methods - as a continuation of classical control theory taught in Linear Control Theory. Emphasis is placed on the treatment of such concepts as controllability and observability, pole allocation, the realization problem, observers, and linear quadratic optimal regulators.

【Grading】The grading is based on the evaluation of reports and final examination.

【Course Goals】The objective is to study controllability and observability that are the basis of modern control theory, and also understand design methods such as optimal regulators. It is hoped that the course provides a basis for a more advanced topic such as robust control theory.

【Course Topics】

Theme	Class number of times	Description
Introduction to modern control	1	We give real examples for which the modern control theory are applied. We also give a state-space formulation for modeling dynamical systems.
Mathematics for modern control	1	We discuss some fundamental properties of mathematics, in particular, vectors and matrices.
Controllability and observability	2	We introduce the fundamental notions of controllability and observability for linear dynamical systems, and also discuss their basic properties and their criteria.
Canonical decomposition	2	We give the canonical decomposition for linear systems.
Realization problem	2	We introduce the realization problem that constructs state space representations from transfer functions for single-input and single-output systems.
Stability	2	We discuss the stability of dynamical systems described by state-space equations. We also give mathematical tools for checking if a system is stable or not.
State feedback and dynamic compensators	3	We introduce the construction of dynamic compensators via state feedback, pole allocation and observers. The relationships with controllability and observablity are also discussed.
Opimal regulators	2	We give the basic construction of optimal regulators, in particular, the introduction of the matrix Riccati equation, its solvability, relationship to stability and observability, and root loci.

【Textbook】None specified.

【Textbook(supplemental)】Linear Algebra, K. Jaenich, translation by M. Nagata, Gendai-suugakusha,
Mathematics for Systems and Control, Y. Yamamoto, Asakura,

【Prerequisite(s)】It is desirable that the student has studied classical control theory (linear control theory). Fundamental knowledge on linear algebra is assumed, e.g., matrices, determinants, rank of a matrix, dimension of a vector space, isomorphism.

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【Web Sites】

【Additional Information】

90790

Optimization

最適化

【Code】90790 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】Mathematical programming or optimization is a methodology for modeling a real-world problem as a mathematical problem with an objective function and constraints, and solving it by some suitable procedure (algorithm). This course consists of lectures on basic theory and methods in nonlinear optimization and combinatorial optimization.

【Grading】Based on the score of the term examination.

【Course Goals】To understand basic theory and algorithms in continuous optimization and combinatorial optimization.

【Course Topics】

Theme	Class number of times	Description
Fundamentals of nonlinear optimization	2	Basic notions in continuous optimization such as global and local minima, convex sets and functions, gradients and Hessian matrices of multivariate functions.
Method of unconstrained optimization	2	Basic unconstrained optimization methods such as steepest descent method, Newton's method, quasi-Newton methods, conjugate gradient method.
Optimality conditions and duality	2	Optimality conditions for constrained optimization problems, called Karush-Kuhn-Tucker conditions, as well as the second-order optimality conditions and Lagrangian duality theory.
Methods of constrained optimization	1	Basic methods of constrained optimization such as penalty methods and sequential quadratic programing methods.
Combinatorial optimization	1	Typical combinatorial optimization problems such as traveling salesman problem and knapsack problem, and their computational complexity.
Branch-and-bound method and dynamic programming	2	Basic exact solution strategies for combinatorial optimization such as branch-and-bound method and dynamic programming.
Approximation algorithms	3	Approximation algorithms for hard combinatorial optimization problems, and their theoretical performance guarantees.
Summary and review	1	Summary and review. Confirmation of achievement level.

【Textbook】

【Textbook(supplemental)】M. Fukushima, Introduction to Mathematical Programming: New Edition (in Japanese), Asakura Shoten ;

M. Yagiura and T. Ibaraki, Combinatorial Optimization - Metaheuristic Algorithms (in Japanese), Asakura Shoten .

【Prerequisite(s)】Linear Programming (90690) recommended.

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【Web Sites】

【Additional Information】

91230

Nonliner Dynamics

非線形動力学

【Code】91230 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	3	
	3	
	2	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90590

Theory of Information Systems

情報システム理論

【Code】90590 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This course covers modeling and performance evaluation methods for optimal design of information/service systems, focusing on queueing theory and Markov analysis.

【Grading】Based on the score of the term examination

【Course Goals】This course aims to deepen the understanding of the fundamental results of both queuing theory and Markov analysis for the modeling and performance evaluation methods of information/service systems.

【Course Topics】

Theme	Class number of times	Description
Outline of this course	1	The contents of this course are outlined, together with introducing the significance and history of performance evaluation of information/service systems by queuing theory and Markov analysis.
Review of fundamental notions	2 〜 3	The fundamental notions, such as random variables, probability distributions, Markov chains etc., are explained
Performance evaluation of semi-Markovian queues	5 〜 6	The following performance measures are delivered: the stationary queue length distribution and waiting time distribution of semi-Markovian queues, such as M/G/1 and GI/M/1 queues, in addition to the loss probability of their finite-capacity analogues.
Formulas for performance evaluation	5 〜 6	The following formulas for performance evaluation are lectured: Erlang's loss formula, Little's law, Kingman's inequality, and approximate formulas for multi-server queues.

【Textbook】Handouts are provided.

【Textbook(supplemental)】P. Bremaud, Markov Chains: Gibbs Fields, Monte Carlo Simulation, and Queues, Springer, 1999.
L. Kleinrock, Queueing Systems Vol.1, John Wiley and Sons, 1975.
L. Kleinrock, Queueing Systems, Vol.2, John Wiley and Sons, 1976.
D. P. Heyman and M. J. Sobel, Stochastic Models in Operations Research, Vol. 1, Dover Publications, 2003. .

【Prerequisite(s)】Stochastic discrete event systems, and basics of queueing theory.

【】

【Web Sites】

【Additional Information】

91330

Computer Architecture

計算機アーキテクチャ

【Code】91330 【Course Year】3rd 【Term】2018・first semester 【Class day & Period】Tuesday・2

【Location】Research Building #7, Lecture Room #1 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture

【Language】Japanese 【Instructor】Hiroshi Nakashima, Professor, Academic Center for Computing and Media Studies

【Course Description】We learn pipelined instruction execution, memory hierarchy and parallel processing mechanism in modern computers.

【Grading】Your achievements in end-of-term exam and per-class exercises are evaluated with respect to the "Course Goals".

【Course Goals】Understanding the following topics so that you explain them to other people.

1. Instruction Pipeline
2. Memory Hierarchy
3. Parallel Processors

【Course Topics】

Theme	Class number of times	Description
Instruction Pipeline (1)	1	Overview of pipelining
Instruction Pipeline (2)	1	Pipelined data-path and its control mechanism
Instruction Pipeline (3)	1	Data hazards
Instruction Pipeline (4)	1	Control (branch) hazards and execptions
Instruction Pipeline (5)	1	Instruction-level parallelism
Memory Hierarchy (1)	1	Meomory technology Cache (1)
Memory Hierarchy (2)	1	Cache (2)
Memory Hierarchy (3)	1	Cache (3)
Memory Hierarchy (4)	1	Virtual memory (1)
Memory Hierarchy (5)	1	Virtual memory (2)
Memory Hierarchy (6)	1	Other concepts of memory hierarchy
Parallel Processors (1)	1	Overview, SIMD extension, Vector processors
Parallel Processors (2)	1	Multithreading, Cache coherence
Parallel Processors (3)	1	Shared Memory Multiprocessors
End-of-term Exam	1	
Feedback	1	Explanatoin of exam problems

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 5th ed.No. 2,
by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP

【Textbook(supplemental)】

【Prerequisite(s)】Though not a mandatory prerequisite, you are expected to having received the credit of "Computer Organization" for 2nd-year students.

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【Web Sites】https://panda.ecs.kyoto-u.ac.jp/portal/
The page of "Computer Architecture" and its subordinates linked from the PandA portal shown above.

【Additional Information】Office Hour: 16:30-17:30, every Thursday
Office: Room 411, 4F, Research Bldg. #5

91030

Operating System

オペレーティングシステム

【Code】91030 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	9	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91340

machine learning

機械学習

【Code】91340 【Course Year】3rd (CS), 4th (AMP) 【Term】2nd Semester
【Class day & Period】Wednesday, 2nd Slot 【Location】Research Building #7, Lecture Room #1 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Professor Tatsuya Kawahara
【Course Description】This course provides foundations of Pattern Recognition and Machine Learning, which extract useful information for classification and decision making from real-world large-scale data. It covers a variety of machine learning techniques oriented for pattern recognition.
【Grading】The grading is based on the examination following the course, and some exercises provided in the course.
【Course Goals】to master basic approaches and major techniques of machine learning.
to be able to design a system that classify and recognize real-world patterns.
【Course Topics】

Theme	Class number of times	Description
Introduction	2	problems of pattern recognition and basic approaches, supervised learning linear discriminant function, minimum distance classifier, quadratic discriminant function, machine capacity
Learning based on statistical models	4	normal distribution, variance, co-variance, Mahalanobis distance clustering, Gaussian mixture model DP matching, HMM, Viterbi algorithm Bayes decision, loss function, maximum likelihood classification, naive Bayes classifier, logistic regression model
Learning based on neural networks	5	perceptron, error correction learning multi-layer perceptron, error back-propagation learning support vector machines deep learning, convolutional neural network, auto-encoder, recurrent neural network
statistical feature extraction and learning criteria	2	KL expansion, principal component analysis, discriminant analysis minimum mean square error estimation, maximum likelihood estimation, Bayesian learning, regularization
design and evaluation of pattern recognition systems	1	database, big data, cross-validation
	1	

【Textbook】Indicated in the Japanese page
【Textbook(supplemental)】Pattern Classification (Richard O. Duda, Peter E. Hart, and David G. Stork, Wiley) , Learning Machines (N.J.Nilsson, Morgan Kaufmann) ,
（学習機械 (渡辺茂訳，コロナ社)）
【Prerequisite(s)】
【】
【Web Sites】
【Additional Information】The contents above will be changed according to some reasons, e.g. the total number of classes in the term.

90980

Databases

データベース

【Code】90980 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	4	
	2	
	2	
	3	
	3	

【Textbook】

【Textbook(supplemental)】Raghu Ramakrishnan and Johannes Gehrke-- Database Management Systems, 3rd edition, McGraw-Hill, 2002.
J.D.Ullman: Principles of Database and Knowledge-base Systems Vol.1,Computer Science Press, 1988 .
Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: Database Systems: The Complete Book, Pearson; 2nd International, 2008.
C.J. Date: An Introduction to Database Systems, Addison Wesley; 8th edition, 2003.
Serge Abiteboul, Richard Hull, Victor Vianu: "Foundations of Databases", Addison Wesley, 1994.

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

90540

Reading and Writing Scientific English

技術英語

【Code】90540 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】 【Language】English, Japanese 【Instructor】

【Course Description】How is it that scientists from all over the world can all share and contribute to the world's most advanced scientific discoveries, despite coming from very different linguistic backgrounds? The key to that success is the reliance on a common language: scientific english. Scientific english is a streamlined version of english, designed to convey complex ideas as clearly as possible. In this class, three lecturers introduce English technical writing, presentation and reading :

1. English technical writing

Writing a scientific paper or a patent proposal in english requires a different skill set than writing other types of documents in english (letter, announcement, speech etc..). We will survey in this section of this course the following relevant topics:

- Basic rules of scientific paper writing and avoidable mistakes;
- Differences between scientific english and scientific japanese;
- Typography, proofreading, figures: tools to maximize quality and impact;
- Research interactions in an international publishing environment:
reviewing, rebuttals & letters to editors.

2. Technical presentation

In the presentation classes, we will learn the basic presentation skills by

- watching videos of example good/poor presentations;
- learning the typical organizations of technical presentations;
- making and presenting slides for the particular topic.

3. Reading technical papers in English

Reading technical papers requires a skill to understand logical and mathematical expressions, besides basic reading comprehension. The key is to grasp the context in English without word-for-word translation. In the classes, we pick up materials from techincal papers or textbooks and read them together.

【Grading】Your grade is determined by your performance of class attendance and the scores of exercises and reports. Passing grades in all topics are required.

【Course Goals】You will acquire basic knowledge and skill for reading, writing and presenting technical materials in English.

【Course Topics】

Theme	Class number of times	Description
English writing	5	Learn English technical writings.
English reading	5	Learn reading English technical documents.
Technical presentation	5	Learn basic / technical presentation skills in English.

【Textbook】We will deliver supplemental materials in classes.

【Textbook(supplemental)】"SPEAKING of SPEECH (New Edition)", David Harrington and Charles LeBeau, MACMILLAN.

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】You are expected to attend class regularly.

91110

Information Systems

情報システム

【Code】91110 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	3	
	2	
	1	
	2	
	2	
	2	
	2	
	1	
	2	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

90551

Theory of Algorithms

アルゴリズム論

【Code】90551 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】We introduce a computation model suitable for discussing both time and space complexities of algorithms and problems, then study basic ideas and issues of computational complecity theory.

【Grading】Two reports and a final exam.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
review of language and automata theory	2	
Turing machines	4	Basic properites of Turing machites including their computation power and several equivalent machines.
Decidability and Undecidability	3	The notion of decidability of problems and examples of undecidable problems.
Introduction of complexity theory	6	Decidable but intractable problems and NP-completeness. Discussion to check the achievements of students

【Textbook】Iwama, Introduction to theory of algorithms, Shoko-do, 2001 .

【Textbook(supplemental)】

【Prerequisite(s)】91040

【】

【Web Sites】

【Additional Information】

91350

digital signal processing

デジタル信号処理

【Code】91350 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2-3	
	1-2	
	1	
	1-2	
	1	
	1	
	1	
	1-2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91360

Foundations of Statistical Modeling

統計的モデリング基礎

【Code】91360 【Course Year】3rd year 【Term】second 【Class day & Period】Wed.4

【Location】Building7.room1 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture

【Language】Japanese 【Instructor】professor Hisashi Kashima

【Course Description】This course gives foundations of statistical data modeling methods to capture the uncertainty in target systems and to estimate the probability of future events for prediction and control.

【Grading】Mid-term and final examinations

【Course Goals】The goal of this course is to learn how to choose and apply appropriate processing and modeling approaches to analyze various types of data.

【Course Topics】

Theme	Class number of times	Description
Basic ideas	1	Basic ideas of statistical data analysis
	1	
Regression models	1	Linear regression model and estimation methods
Model estimation	2	Model estimation frameworks including maximum likelihood estimation
Model selection	2	Model selection frameworks including information criterion
Models for categorical data	2	Predictive models for categorical data including logistic regression
Correlation and causation	2	Difference between correlation and causation. Methods for estimating causality.
Bayesian estimation	2	Statistical inference methods based on Bayesian statistics
Models for various data types	2	Models for various data types including time series and texts

【Textbook】None

【Textbook(supplemental)】They will be given in the lectures

【Prerequisite(s)】Basic knowledge of probability and statistics

【】Exercises on real data analysis.

【Web Sites】The course website will be given in the lectures

【Additional Information】Office hours are available upon request. An appointment is needed by sending an email to kashima@i.kyoto-u.ac.jp

90990

Software Engineering

ソフトウェア工学

【Code】90990 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Software Requirements Engineering	2	
Software Design Techniques	2	
Software Process	1	
Software Quality Management	1	
Business Model Innovation	1	
Project Management	1	
Software Modules	1	
Softwre Tests	1	
Formal Methods	1	
Software Metrics	1	
Software Maintenance and Evolution	1	
Summary and Assessment	1	

【Textbook】

【Textbook(supplemental)】Ian Sommerville: "Software Engineering 10th Edition", Pearson, 2016.

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91370

pattern data processing

パターン情報処理

【Code】91370 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】This course provides an overview of technologies to handle, recognize and generate a variety of information media or pattern data such as text, speech and image.

【Grading】based on the examination following the course

【Course Goals】to master basic methods to deal with text, speech and image, and also processing of their analysis, recognition, and synthesis.

【Course Topics】

Theme	Class number of times	Description
Introduction	2	review on information media and pattern data methods to handle them with computers
text and natural language processing	1	morphological analysis, syntactic analysis, and semantic analysis of natural language character code, font and text retrieval
speech processing	4	AD conversion and frequency analysis of speech computational model of speech production and speech analysis speech recognition, speech synthesis spoken dialogue systems
	2-3	
	2-3	
	2-3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】The contents above will be changed according to some reasons, e.g. the total number of classes in the term.

90860

Computation and Logic

計算と論理

【Code】90860 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	6	
	7	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91190

Bioinformatics

生命情報学

【Code】91190 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takatsune Kumada (Graduate School of Informatics, Professor)
Tatsuya Akutsu (Institute for Chemical Research, Professor)

【Course Description】This course overviews mathematical models and computational methods in bioinformatics. In particular, this course explains how such methods as graph theory, machine learning, optimization, and nonlinear differential equations are applied to analyses of biological sequences and biological systems including neural and brain systems. This course is given in Japanese.

【Grading】See Japanese page for details.

【Course Goals】See Japanese page for details.

【Course Topics】

Theme	Class number of times	Description
Neural information processing in brain	1	
Visual information processing	2	
Visual attention	2	
Cognitive function	2	
Overview of bioinformatics	1	
Sequence analysis	1	
Inference of phylogenetic trees	2	
Hidden Markov models	1	
Analysis of protein structures	1	
Scale-free networks	1	
Feedback	1	

【Textbook】

【Textbook(supplemental)】Textbooks or recommended books will be informed in the course as required. The latter part of the course, a recomennded book is as follows (in Japanese); 阿久津達也　著：バイオインフォマティクスの数理とアルゴリズム，共立出版 (2007) .

【Prerequisite(s)】Basic knowledge related to biology and brain science will be provided in the course.

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【Web Sites】

【Additional Information】The oder and contents of the course topics can be changed.

91390

情報符号理論続論

【Code】91390 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Toshiyuki TANAKA, Professor, Graduate School of Informatics, Jun OHKUBO, Assistant Professor, Graduate School of Informatics
【Course Description】This course discusses information theory, which is a basic mathematical theory on storing and communicating information. Building on the subjects covered in the course "Information and Coding Theory," the subjects covered by this course will include differential entropy for a continuous-valued random variable, Gaussian channels, and universal source coding. Advanced topics such as rate-distortion theory and network information theory will be reviewed as well.
【Grading】Grading is done on the basis of evaluation of both written assignments given in the class and the end-term examination.
【Course Goals】Aims at achieving understanding of notions in information theory to be dealt with in the course at the level that allows one to appropriately answer problems given as examples as well as in exercises.
【Course Topics】

Theme	Class number of times	Description
Introduction	1	Basic concepts such as information entropy, mutual information, source coding, and channel coding are revisited.
Information theory for continuous-valued random variables	4	In view of wireless communication and measurements, a theory that can deal with continuous-valued random variables. Differential entropies for such random variables are introduced, on the basis of which information transmission capability of a Gaussian channel is discussed as the most basic example.
Universal source coding	4	Although source coding theorem assumes that the underlying probability distribution is known, in many practical situations one cannot assume such knowledge. Means of achieving efficient data compression even in such situations are described.
Rate-distortion theory	3	If one allows a certain degree of degradation of information, one can achieve better data compression than the case where one does not allow degradation. Rate-distortion theory, a theory for information compression allowing degradation, is discussed.
Network information theory	2	Advances and spread of information and communication technologies have been stimulating discussion on many-to-many communications over networks, beyond one-to-one communications. Network information theory, which deals with communications in such frameworks, is discussed.
Achievement check and feedback	1	Achievement check of learning of this course, as well as answering questions arising from the course and giving advise on further learning.

【Textbook】T. M. Cover and J. A. Thomas, Elements of Information Theory, 2nd ed., Wiley-Interscience, 2006.
【Textbook(supplemental)】To be introduced in the class.
【Prerequisite(s)】Assumes basic knowledge on probability theory, as well as knowledge treated in the course "Information and Coding Theory". Knowledge of statistics and Markov chains should be helpful.
【】
【Web Sites】
【Additional Information】

90810

Signals and Systems

信号とシステム

【Code】90810 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	3	
	2	
	2	
	2	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91180

Analysis in Mathematical Sciences

数理解析

【Code】91180 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】,,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	5	
	3	
	2	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91210

Business Mathematics

ビジネス数理

【Code】91210 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】It is important to learn the mechanism of the business and the process of the value creation in understanding the contemporary society. I introduce various theories of the business strategy including the finance, accounting, risk management, R&D and marketing. Moreover, how the technique and the idea of mathematical engineering are used in the phase of various decision makings of the business.

【Grading】Written examination (70%), and attendance and the class participation (30%)

【Course Goals】The target of the class is to obtain enough knowledge about an outline, a vital point of the business strategy and the effectiveness of mathematical methods.

【Course Topics】

Theme	Class number of times	Description
Evaluation of corporate value and business strategy	4	
Finance and accounting	2	
Business strategy	6	Bayes theorem (strategic change by acquisition of information by marketing); Optimization technique (decision of business portfolio and sales price); Decision tree and real option (research management); Game Theory (environmental solution)
Business risk management	2	
Summary and review	1	Summary and review; Confirmation of achievement level.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91080

Information and Business

情報と職業

【Code】91080 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	7	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

91410

情報セキュリティ演習

【Code】91410 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】1

【Restriction】When it is difficult to accept all students due to the restrictions of facilities, we give priority to Basic SecCap students in Kyoto University.

【Lecture Form(s)】Seminar 【Language】Japanese 【Instructor】

【Course Description】IDS (Intrusion Detection System), which detects attempts of unauthorized access, creates an enormous number of alarms, and it is difficult to analyze them manually. In this class, students learn the mechanism and role of IDS, and classify normal communication and attacks from IDS alarms by machine learning.

【Grading】The achievement of the tasks and the content of the presentations within the class.

【Course Goals】Students understand the role of IDS in network security.
Students understand the mechanism of signature-based IDS, and can explain advantages and disadvatages of the IDS. Students understand the mechanism of intrusion detection by machine learning, and can explain advantages and disadvantages of machine learning approach.

【Course Topics】

Theme	Class number of times	Description
Guidance	2	Guidance on how this class is operated, and how to use computing facility for this class. Basic knowledge on the role of IDS in network security and how machine learning can help the intrusion detection.
Intrusion Detection by Signature-Based IDS	5	Learn the mechanism of intrusion detection by signature-based IDS by studying open source signature-based IDS and attacks, such as correspondence between alarms issued from IDS and communications, and adding signatures to detect attacks.
Intrusion Detection by Machine Learning	7	Learn the method of classifying normal and malicious traffic by machine learning algorithms and public dataset for benchmarking intrusion detection performance.
Presentation	1	Based on the exercise, students presents their methods of intrusion detection using machine learning, and discuss it with other students and instructors.

【Textbook】Instructors give handouts.

【Textbook(supplemental)】No

【Prerequisite(s)】Students should be able to have basic knowledge of Linux operations (editing files, etc). Students should be able to write simple programs by Python.

【】Students should be able to have basic knowledge of Linux operations and Python.

【Web Sites】

【Additional Information】Students should bring their laptop for this class. Students who cannot bring their laptop should contact to instructors in advance.

21050

Engineering Ethics

工学倫理

【Code】21050 【Course Year】4th year 【Term】2018 first semester 【Class day & Period】Thu 3rd 【Location】Research Bldg. No.8, 3F, NS Hall 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Dean of the Faculty of Engineering
Graduate School of Engineering, Professor, Makoto OHSAKI
Graduate School of Energy Science, Professor, Hirohiko TAKUDA
Graduate School of Engineering, Junior Associate Professor, Ryosuke MATSUMOTO

【Course Description】Modern ethics based on engineering aspect are becoming essential to present engineers and scientists. Instructors from various faculties give lectures about ethics in their research fields.

【Grading】Class participation and reports.

【Course Goals】The goal of this class is to understand engineering ethics, and to develop the ability to judge by yourself when you encounter ethical issues.

【Course Topics】

Theme	Class number of times	Description
Significance to learn engineering ethics(4/12)	1	This class gives students explanation about what engineering ethics is and the reason why it is necessary to learn it introducing some troubles in the field of transportation engineering and planning. (N. Uno: Global Engineering)
Ethics in information society on the view point of information technology(4/19)	1	Information devices such as PCs and smartphones and various web services such as SNS are very convenient, but there are also risks of being dangerous depending on usage. In this lecture, we describe the knowledge and the code of conduct to live safely in the information society. (A. Yamamoto: Informatics and Mathematical Science)
(4/26)	1	(M. Mizutani: Graduate School of Letters)
Ethical theories for engineering ethics (5/10)	1	This lecture will focus on basic ethical theories such as utilitarianism, deontology and virtue ethics which will be useful for thinking about particular ethical problems in engineering ethics. (S. Kodama: Graduate School of Letters)
Ethics in Architectural Engineering(5/17)	1	Discussions will be held to increase the ability as engineers to responsibly confront moral issues in the field of building engineering using actual technological activities as examples, such as putting water into fresh concrete, falsification of earthquake-resistance data, shoddy workmanship and architect qualification fraud. (M. Nishiyama: Architecture)
Engineering ethics in operation and maintenance of structures(5/24)	1	Although operation and maintenance of structures such as a plant and an aircraft require enormous labor and cost, unsuitable operation and maintenance may lead to serious accidents that cause unmeasurable damage. This class discusses engineering ethics that engineers are required under the situation. (T. Hayashi: Engineering Science)
Research and engineering ethics(5/31)	1	It is said that He that will do no ill, must do nothing that belongs thereto. The sense of ethics necessary to whom conducts research and engineering work in society is discussed in terms of the importance of equitability and fair evaluation to anyone involved in each area of research or engineering. (H. Mikada: Global Engineering)
Patents and Ethics (Part 1)(6/7)	1	This course will teach the students about 1) patent systems which protect inventions and research results and 2) ethical issues in patents. The first class, in preparation for the next subject of patent ethics, introduces Japan ’ s patent system with comparisons to the patent systems in the world ’ s major countries and international framework. (M. Nakagawa: Electrical and Electronics Engineering)
Patents and Ethics (Part 2) (6/14)	1	Students, equipped with the basic knowledge of patent systems by the previous lecture, will get familiar with actual case studies on ethical and legal issues in patents. (M. Nakagawa: Electrical and Electronics Engineering)
Ethics Required for Advanced Science(6/21)	1	Engineers and researchers are at the forefront of preventing harm caused by advanced chemistry. Think about social roles and ethics required by engineers and researchers through relationships between chemical substances and environmental problems, efforts to avoid hazards of nanomaterials. (K. Miura: Industrial Chemistry)
Ethics in nuclear engineering(6/28)	1	Nuclear technology can brew up an expansive and long-running catastrophe as well as it brings significant value of stable electricity in normal times. Some examples of ethics in nuclear engineering are introduced and important issues are talked. (I. Takagi: Engineering Science)
Ethics in biomedical engineering(7/5)	1	Recent dramatic progress in biology-related techniques, such as reproductive medicine, genome editing, and clone-animal techniques, is causing revolutions in the fields of medicines and food productions. Associated with it, problems of their safety and ethics are arising, which should be addressed by our societies. In this class, the recent progress in biology-related techniques, and problems we have and will have in near future are described. (M. Shirakawa: Industrial Chemistry)
Ethics of biotechnology and stem cell research(7/12)	1	With the rapid development of genome editing technology and stem cell engineering, editing of the human genome that goes beyond generations has become possible, at least technically. In this lecture, I will introduce these latest technologies and think about ethical problems accompanying technological development. (G. Eiraku: Industrial Chemistry)
Art-view Concept for Engineering(7/19)	1	Concept of "quality of life" is required for human related engineering. Some practical examples in medical-care and welfare fields will be introduced, and problem of the QOL-evaluation will be discussed from both function-optimizing view point and art view point. (N. Tomita: Engineering Science)
Ethics for Civil Engineers (7/26)	1	Civil Engineers play a key role on development of social infrastructures to protect people's lives from natural disasters and to support social and economic activities. This lecture introduces the engineering ethics on development of social infrastructures with specific examples. (T. Yagi: Global Engineering)

【Textbook】Lecture materials will be distributed.

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】The class order is subject to change.

21080

Introduction to Engineering

工学序論

【Code】21080 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】1

【Restriction】No Restriction 【Lecture Form(s)】 【Language】 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1~2	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

22210

Engineering and Economy(in English)

工学と経済（英語）

【Code】22210 【Course Year】2nd year and above 【Term】2018 first semester 【Class day & Period】Tuesdays 5th-6th

【Location】工学部総合校舎１１１講義室 【Credits】2 【Restriction】【Lecture Form(s)】【Language】English 【Instructor】Juha Lintuluoto

【Course Description】The purpose of this course is to teach economy from an engineer viewpoint. The course especially contains such economic topics which engineer can use to solve practical engineering economy problems. The course is consisted of lectures and additional exercises, of which the student should complete five (5) written short reports and five (5) 60 minutes laboratory session attendances. The laboratory sessions are held weekly after the lecture, and consist of interactive group work tasks. Laboratory sessions are held weekly from 18 to 19 o’clock.// The course is aimed for both Japanese and Foreign nationals.// The course starts on April 10th.

【Grading】Test, reports, laboratory performance.

【Course Goals】This course will provide tasks for engineering students to be able to understand relationships between engineering and engineering economy. Students will learn solving economic problems related to engineering project at various levels. The course also prepares the students to write engineering related economic topics in English as well as verbally express themselves of these subjects.

【Course Topics】

Theme	Class number of times	Description
Student orientation, Introduction to engineering economy	1	Course introduction; Principles of engineering economy
Cost concept	1	Cost terminology; Competition; Total revenue function; Breakeven point
Design economics	1	Cost-driven design; Making vs. purchasing; Trade-offs
Cost estimation techniques I	1	Integrated approach and WBS; Index, unit, and factor techniques
Cost estimation techniques II	1	Parametric estimating; Power-sizing technique; Learning curve; Cost estimation, bottom-up, top-down, target costing
The time value of money I	1	Simple interest; Compound interest; Equivalence concept;Cash-flow digrams
The time value of money II	1	Present and future equivalent values of single cash flows
The time value of money III	1	Uniform series cash flows; Deferred annuities; Uniform gradient cash flows; Nominal and effective interest rates
Evaluation of a single project I	1	Determining minimum attractive rate of return (MARR); The present worth method; Bond value; Capitalized-worth method
Evaluation of a single project II	1	The future worth method; The annual worth method; The internal rate of return method; The external rate of return method
Comparison and selection among alternatives I	1	Basic concepts; The study (analysis) period; Useful lives are equal to the study period
Comparison and selection among alternatives II	1	Useful lives are unequal to the study period; Repeatability; Cotermination; The imputed market value technique
Income taxes and depreciation	1	Concepts and terminology; Depreciation; Straight-line method; Declining-balance method; Income taxes; Marginal tax; Gain or loss on the disposal of an asset; After-tax economic analysis
Final test	1	The test is based on the above topics

【Textbook】Sullivan, Wicks, Koelling; Engineering Economy, 15th Ed. 2012 , Chapters 1-7.

【Textbook(supplemental)】

【Prerequisite(s)】Note:

-Interactive lessons (discussion), Small group working method

-This course is held in English.

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【Web Sites】None

【Additional Information】If you have any questions or need further information, feel free to contact at 090aglobal@mail2.adm.kyoto-u.ac.jp.

24010

Global Leadership Seminar I

ＧＬセミナーＩ（企業調査研究）

【Code】24010 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2~3	
	2~3	
	12	
	3~4	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

25010

Global Leadership Seminar II

ＧＬセミナーⅡ（課題解決演習）

【Code】25010 【Course Year】2nd year or higher 【Term】FY2018, 2nd semester, intensive
【Class day & Period】Intensive course 【Location】Announced elsewhere 【Credits】1
【Restriction】Restricion in number to around 20 selected students 【Lecture Form(s)】Lecture and excercise
【Language】
【Instructor】Faculty of Engineering, J. Assoc. Prof., Yoshinori Tanaka
Faculty of Engineering, J. Assoc. Prof., Ryuichi Ashida
Faculty of Engineering, J. Assoc. Prof., Aiko Takatori
Faculty of Engineering, J. Assoc. Prof., Tadao Mizuno
Faculty of Engineering, J. Assoc. Prof., Ryosuke Matsumoto
Related professors
【Course Description】This course is a small-group workshop program where students are supposed to extract or set up challenges by themselves aiming at creating new social values. In concrete, abilities of planning and problem-solving are trained through group works in residential training and skills of presentation and communication are enhanced through oral presentations regarding contents of the proposal at each step of the process from a preliminary draft to its completion.
【Grading】It is required to join the residential training. A report meeting is held and comprehensive evaluation concerning abilities in group discussion to extract or set up challenges and to propose solutions for achieving a goal is made through presentation of the proposal as well as a submitted report.
【Course Goals】Ability of planning, from extraction or setting up challenges to proposal of solutions aiming at creating new social values, is trained through group works.
【Course Topics】

Theme	Class number of times	Description
Orientation	1	A brief overview and a schedule of the course are explained and working groups are organized.
Lectures	2	Lectures by experts are given.
Group works	3	Setting up challenges, extraction of problems, collecting information, and group works are done.
Residential training	7	Through intensive group works based on discussion, a proposal for solving problems is planned, a draft report is made, and a few presentations are made.
Preliminary review meeting	1	A preliminary review meeting is held and discussions are made.
Report meeting	1	Final presentations are made and reports are submitted.

【Textbook】Will be indicated as necessary.
【Textbook(supplemental)】Will be indicated as necessary.
【Prerequisite(s)】
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【Web Sites】
【Additional Information】Course open period: October to January
How to register the course will be instructed.
*It depends on divisions which students belong to whether the earned credits are admitted as credits required for graduation. Please refer to the syllabus of your division.

24020

International Internship of Faculty of Engineering I

工学部国際インターンシップ１

【Code】24020 【Course Year】Junior and Senior students 【Term】Through the academic year

【Class day & Period】Intensive course 【Location】Defined in each internship program. 【Credits】1

【Restriction】Defined in each internship program 【Lecture Form(s)】Exercise 【Language】English, et al.

【Instructor】Chairperson of Foreign Students and International Academic Exchange Subcommittee, Faculty members in charge of educational affairs of the undergraduate school the registrant belongs to.

【Course Description】Acquisition of international skills with the training of foreign language through the internship programs hosted by the University, the Faculty of Engineering, or the undergraduate school the applicant belongs to.

【Grading】Marit rating is done based on the presentation or reports after each internship program. Each Ｄepartment responsible to identify if the credit earned by this subject to be included as mandatory ones or not. If the credit is not included in the undergraduate school in which the participant belongs to, the credit is granted by the Global Leadership Education Center as a optional credit. The number of credits, either 1 or 2, will be determined depending on the contents and the duration of the program that the participant has participated in.

【Course Goals】The acquisition of international skills with the training of foreign language through the to internship programs hosted by the University is the major expectation to the students.

【Course Topics】

Theme	Class number of times	Description
Overseas Internship	1	The contents to be acquired should be described in the brochure of each internship program.
Final Presentation	1	A presentation by the student is required followed by discussion among participants.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Described in the application booklet for each internship program. The registrant is requested to have enough language skills for the participation.

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【Web Sites】

【Additional Information】It is required for students to check if the internship program to participate in could be evaluated as part of mandatory credits or not and could earn how many credits before the participation to the undergraduate school or educational program the student in enrolled. If the credit could not be treated as mandatory ones, get in touch with the Global Leadership Engineering Education Center.

25020

International Internship of Faculty of Engineering 2

工学部国際インターンシップ２

【Code】25020 【Course Year】Junior and Senior students 【Term】Through the academic year

【Class day & Period】Intensive Course 【Location】Defined in each internship program. 【Credits】2

【Restriction】Defined in each internship program. 【Lecture Form(s)】Exercise 【Language】English, et al.

【Instructor】Chair of Foreign Students and International Academic Exchange Subcommittee, Faculty members of the Undergraduate School the registrant belongs to.

【Course Description】Acqusition of international skills with wth the training of foreign language through the participation to the international internship programs held by the Faculty of Engineering or its subsidiary bodies.

【Grading】Marit rating is done based on the presentation or reports after each internship program. Each Department responsible to identify if the credit earned by this subject to be included as mandatory ones or not. If the credit is not included in the undergraduate school in which the participant belongs to, the credit is granted by the Global Leadership Education Center as a optional credit. The number of credits, either 1 or 2, will be determined depending on the contents and the duration of the program that the participant has participated in.

【Course Goals】The acquisition of international and foreign language skills through the participation to international programs is expected. Detailed objectives of the participation should be identified by each program.

【Course Topics】

Theme	Class number of times	Description
Overseas Internship	1	The contents to be acquired should be described in the brochure of each internship program.
Final Presentation	1	A presentation by the student is required followed by discussion among participants.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Described in the application booklet for each internship program. The registrant is requested to have enough language skills for the participation.

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【Web Sites】

【Additional Information】It is required for students to check if the internship program to participate in could be evaluated as part of mandatory credits or not and could earn how many credits before the participation to the undergraduate school or educational program the student in enrolled. If the credit could not be treated as mandatory ones, get in touch with the Global Leadership Engineering Education Center.

53000

Introduction to Elecronics

エレクトロニクス入門

【Code】53000 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	5	
	2	
	5	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

50182

Quantum Physics 1

量子物理学１

【Code】50182 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Miyadera,

【Course Description】

【Grading】examination

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	2	
Fundamental framework of quantum theory	4	
Quantization	3	
Particle motion in one dimension	3	
Harmonic oscillator	2	
WKB approximation	2	
Particle motion in three dimensions (2)	1	
Confirmation of achievement in study	1	

【Textbook】

【Textbook(supplemental)】Modern Quantum Mechanics (J.J.Sakurai)
Lectures on Quantum Theory (C.J. Isham)

【Prerequisite(s)】Classical mechanics, Linear algebra

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【Web Sites】

【Additional Information】

50192

Quantum Physics 2

量子物理学 2

【Code】50192 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Miyadera,,

【Course Description】

【Grading】examination

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Fundamental framework of quantum mechanics	2	
Angular momentum	3	
Central potential	2	
Perturbation theory (stationary method)	2	
Perturbation theory (interaction picture)	2	
Many particle system	2	
Recent developments	1	
Confirmation of achievement in study	1	

【Textbook】

【Textbook(supplemental)】Modern Quantum Mechanics (J.J.Sakurai)
Lectures on Quantum Theory (C.J. Isham)

【Prerequisite(s)】Quantum Physics 1

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【Web Sites】

【Additional Information】

60100

Electronic Circuits

電子回路

【Code】60100 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Kazuhiko SUGIYAMA

【Course Description】Following the lecture of fundamentals of active device circuits in the course "Electric and Electronic Circuits", modeling of active devises, fundamentals of transistor circuits, various amplifier circuits, negative feedback in circuits, operational amplifiers, and oscillators are lectured. Nonlinear circuits, power supplies, and noise would be included in the course, when the lecture time remains.

【Grading】Examination and reports. More details are opened on the homepage of this lecture located on PandA.

【Course Goals】The goal of this course is to acquire the fundamentals of electronic circuits. Starting with understanding of a fundamental concept of electronic circuits i.e., modeling of active devices, the lecture based on the fundamental concept proceeds step by step to understand electric circuits. In this style, the lecturer wants to give the students an ability to understand the principles of more complicated circuits by application of deep understanding the fundamentals. The main targets to be understood are the circuits with bipolar transistors and operational amplifiers, as well as the fundamental concepts.

【Course Topics】

Theme	Class number of times	Description
Modeling of active devices	3	The essential concepts in the electronic circuit are lectured in order to treat active devices in the electric circuit theory. The concepts are the controlled source and the linearization. The decoupling between the bias and the signal, another important concept, is lectured.
Fundamentals of transistor circuits	3	The characteristics of the basic bipolar-transistor circuits of three different common references are lectured based on the operation principle of the bipolar transistor. The biasing circuits are lectured with somewhat practical circuits.
Various amplifier circuits	3	Several power amplifier circuits are lectured as we focus on their power efficiencies. DC amplifier circuits are lectured as we bear in mind that they are applied in operational amplifiers.
Operational amplifiers	2	The concept and advantages of the negative feedback circuit are lectured, and an important concept in the operational amplifier, the virtual short, is explained. The linear operational circuits such as integrator and differential circuits, and nonlinear operational circuits such as logarithmic and exponential amplifiers are introduced.
Oscilators	2	The principle of the oscillator circuit is lectured as a concept of the positive feedback. Various oscillator circuits are introduced with their characteristics.
Others	1	If we have a more lecture time, nonlinear circuits of multiplier and modulation/demodulation circuits, power supplies for electronic circuits, and the noise in electronic circuits will be lectured.
Examination	1	We make an examination in order to investigate the achievement in the lecture. We will offer an additional chance for discussion to the students who do not achieve satisfactorily.

【Textbook】M. Kitano, Fundamentals of Electronic Circuits (Reimei Publishing, Kyoto, 2011)

【Textbook(supplemental)】In addition to Japanese books, Tietze and Schenk: Electronic Circuits (Splinger) ;
Hayes and Horowitz: Student Manual for the Art of Electronics (Cambridge)

【Prerequisite(s)】"Electric and Electronic Circuit (60030)" and "Fundamentals of Circuit Theory (60630)". (The lecturer recommends moderate understanding of fundamentals of electric circuit as the minimum prerequisites in order to achieve this course.)

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【Web Sites】Link to the homepage of this course is here; (https://panda.ecs.kyoto-u.ac.jp/portal/site/2018-110-6010-000) or (https://panda.ecs.kyoto-u.ac.jp/portal/). Sorry for Japanese version only.

【Additional Information】The topics will be selected owing to limit of lecture time. The students should prepare "Bar Cover" from the website of the Faculty of Electric and Electronic Engineering (http://www.s-ee.t.kyoto-u.ac.jp/ja/student/index.html)) by themselves, and use it as a title page of each report and the exercise in the lecture. The homepage of this course is located on PandA (https://panda.ecs.kyoto-u.ac.jp/portal/). Contact the instructor after the lecture, when the students have any questions.

60320

Modulation Theory in Electrical Communication

通信基礎論

【Code】60320 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Masahiro MORIKURA and Hidekazu MURATA

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4-5	
	5-6	
	4-5	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

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・ Common Subjects of Faculty of Engineering
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