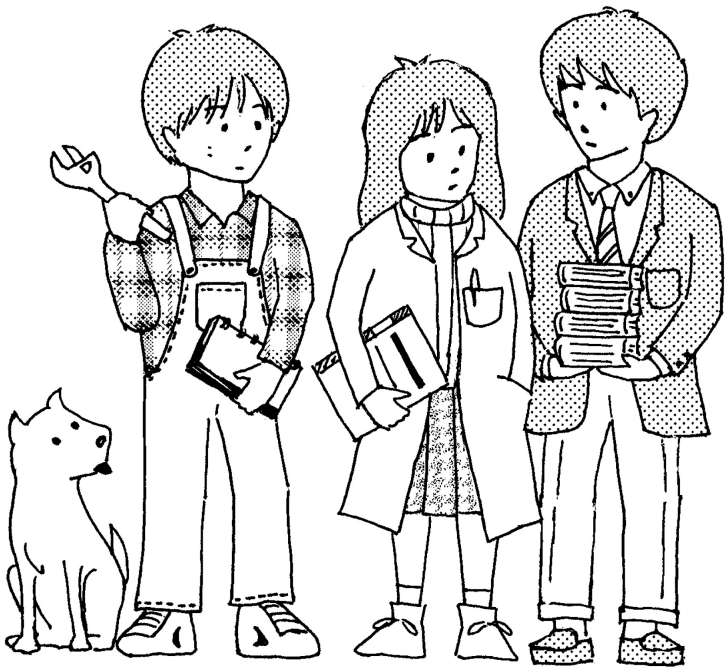
SYLLABUS *2014*

[E] Informatics and Mathematical Science



Kyoto University, Faculty of Engineering

[E] Informatics and Mathematical Science

Informatics and Mathematical Science

91130

Introduction to Computer Science

計算機科学概論

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

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

【Instructor】Naofumi Takagi, Akihiro Yamamoto, Kazuo Iwama

【Course Description】Introduction to Computer Science.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Fundamentals of computer science (Iwama)	4-5	
Computer organaization (Takagi)	4-5	
Applications of computer science (Yamamoto)	4-5	
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】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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	
Quantum Information	4	While the macroscopic world is governed by laws of classical physics, the microscopic world is governed by laws of quantum physics. Recently, a new technology for computation and communication based on quantum physics becomes probable and realistic. We will provide an introductory course on quantum theory and a basic idea of quantum cryptography.
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】2nd term 【Class day & Period】 【Location】 【Credits】2

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

【Instructor】Kazuyoshi Yoshii, Seiji Umatani, Katsutoshi Itoyama

【Course Description】Learn the basic skills of structures and interpretation of computer programs.

【Grading】Examination 70%
Assingments 30%

【Course Goals】To learn the skills of Scheme programming and its philosophy with respect to programming languages.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Goals of the class How to write programs in Scheme
Building Abstractions with Procedures	5	1.1 The Elements of Programming 1.2 Procedures and the Processes They Generate 1.3 Formulating Abstractions with Higher-Order Procedures
Building Abstractions with Data	5	2.1 Introduction to Data Abstraction 2.2 Hierarchical Data and the Closure Property 2.3 Symbolic Data 2.4 Multiple Representations for Abstract Data 2.5 Systems with Generic Operations
Sorting and Searching	3	Sorting -- Internal sorting and external sorting Insertion sort, Bubble sort, Quick sort, Heap sort, Merge sort Binary search, Hashing
Examination	1	End-term examination FInal assignment with Picture Language

【Textbook】"Structure and Interpretation of Computer Programs" (MIT Press)
Online Fulltext (provided by MIT Press)

【Textbook(supplemental)】"Programming Pearls" (ACM Press)
Japanese Translation（Piason Education)

【Prerequisite(s)】Elementary Computer Techniques(23015)
Introduction to Computer Science(91130)

【Web Sites】Lecture HP
Prof. Okuno's Lectures
For further study, I recommend the book written by Gerald Jay Sussman et al. "Structure and Interpretation of Classical Mechanics"

【Additional Information】The contents is subject to change.
Another assignment is to compose a painter by using Picture Language. The pictures created by students of the past classes are available at the Gallery.

90690

Linear Programming

線形計画

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

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Nobuo Yamashita

【Course Description】Lectures on modeling and algorithms of mathematical programming, 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
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	2	Polynomial-time algorithms in linear programming, ellipsoid method and interior point method.
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)】

【Web Sites】

【Additional Information】

60682

Electric Circuits and Differential Equations

電気回路と微分方程式

【Code】60682 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	5	
	1	
	6	
	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】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Hitoshi Yoshikawa

【Course Description】The theory of analytic functions of one complex variable

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

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

【Course Topics】

Theme	Class number of times	Description
The plane of one complex variable and elementary functions	3	After describing the point-set topology of the plane of one complex variable, elementary functions are introduced with their properties.
Complex integrals and Cauchy's theorem	3	Cauchy's theorem and Cauchy's integral formula are shown along with outstanding properties of analytic functions. An example is given of Cauchy's theorem.
Power series	2	Sequences, series, and series of functions are discussed with the notion of convergence and divergence.
Taylor's expansio0n and Laurent's expansion	3	The Taylor series of analytic functions and the Laurent series of analytic functions on an annulus are discussed together with some examples.
Singularity and residues	3	The calculus of residues is dealt with. Examples are given of integral evaluations.
Learning achievement test	1	Learning achievement test.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Calculus, Linear algebra

【Web Sites】

【Additional Information】

90680

Dynamics of Particles and Vibration

質点系と振動の力学

【Code】90680 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】Akito Igarashi

【Course Description】Previous knowledge of basic mechanics is required. The aim of this lecture is to show the basic concepts of dynamics of particles and rigid bodies.

【Grading】Based on quizzes and the semester final exam

【Course Goals】To gain the knowledge of
Dynamics of the system of particles
Motion in a noninertial reference frame
Rigid body dynamics

【Course Topics】

Theme	Class number of times	Description
Dynamics of the system of particles	3	Basic dynamics is briefly reviewed. As fundamental concepts, the total momentum, the total angular momentum and the center of mass are introduced. Some conservation laws are derived.
Motion in a noninertial reference frame	3-4	Rotating coordinate systems and the equations of motion are described. Motion in a non-inertial frame is considered.
Rigid body dynamics	7-8	Moment of inertia, inertia tensor and torque are introduced to derive Euler's equations of motion.

【Textbook】None

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

【Prerequisite(s)】Fundamental Physics A

【Web Sites】None

【Additional Information】

90890

Applied Mathematics and Physics Laboratory

数理工学実験

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

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	7	
	7	
	7	
	7	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90900

Exercise on Applied Mathematics and Physics

基礎数理演習

【Code】90900 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	4	
	5	
	5	
	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】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	9	
	2	

【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】1st term 【Class day & Period】 【Location】 【Credits】1

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】, , ,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	2	
	7	
	3	

【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】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】, , , , ,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	7	
	7	

【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】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Yoshito Ohta

【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.

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

【Additional Information】

90700

Logical Systems

論理システム

【Code】90700 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Instructor】Nobuo Yamashita, Liang Zhao,

【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】

91050

Introduction to Dynamical Systems

システムと微分方程式

【Code】91050 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】Hitoshi YOSHIKAWA

【Course Description】This lecture is a basic course of theory of dynamical system.

【Grading】Homeworks and an examination are scored.

【Course Goals】This lecture has three purposes: (1) to master the methods solving differential equations. (2) to practice qualitative analysis. (3) to get able to formulate and to analyze mathematical models.

【Course Topics】

Theme	Class number of times	Description
What is MODEL?	3	A model is an abstractization of an aspect of the actual world. A model is a system of symbols equipped with inference rules. A good model is simple, distinct, having correspondence between symbols and actual phenomena, analyzable and predictable.
Purpose for building models	4	Why we formulate models in terms of differential equations?
Exponential function	4	Definition and properties of exponential function.
Basic method for solving differential equations	3	Linear differential equations.
Qualitative analysis	1	Phase flow, phase diagram, stability, Lyapunov function, linearized approximation, limit cycle.
Applications	2	Equations of motion, models of rocket, planet, ecology.
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】These lectures are given in Japanese.

【Web Sites】

【Additional Information】

90710

Analytical Dynamics

解析力学

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

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

【Instructor】Funakoshi Mitsuaki, Yutaka Kaneko

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	7	
	5	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90970

Logic Circuits

論理回路

【Code】90970 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn logic algebra which is a basis of computer science and a logic circuit which is a basis of digital systems such as computers. First, we learn logic algebra and logic functions, and then minimization of logic functions and design methods of logic circuits. We also learn sequential machine which is a mathematical model of a sequential circuit and its minimization, and design methods of sequential circuits.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

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

【Course Topics】

Theme	Class number of times	Description
Introduction	1	What is a logic circuit? Sets and relations.
Logic algebra and logic function	4	Logic algebra, logic expression, logic function and its representation and its characteristics, etc.
Combinational circuits and their design methods	5	Design methods of combinational circuits, especially minimization methods of logic functions.
Sequential machines and sequential circuits	4	Sequential circuits and their design methods, especially minimization methods of sequential machines and state assignment.
Review	1	

【Textbook】Logic circuits, by Naofumi Takagi, Shokodo

【Textbook(supplemental)】

【Prerequisite(s)】Basic knowledge on sets and relations.

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/lc.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】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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】Two reports and a final exam.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
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	4	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)】

【Web Sites】

【Additional Information】

90160

Computer Architecture 1

計算機アーキテクチャ 1

【Code】90160 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn basic organization of computers, instruction set architecture, and computer arithmetic. We also learn how to design simple computers.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

【Course Goals】1. Understanding basic organization of a computer, and being able to explain it.
2. Understanding instruction set architecture, and being able to explain it.
3. Understanding computer arithmetic, and being able to explain it.
4. Understanding design methods of simple processors, and being able to use them.

【Course Topics】

Theme	Class number of times	Description
Basic organization of a computer	2	Basic organization of a computer
Instruction set architecture	5	Instruction set architecture of a computer
Computer arithmetic	3	Computer arithmetic, arithmetic circuits
Design of simple processors	4	Design of simple processors
review	1	

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 4th ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP
No. 1: ISBN 978-4-8222-8478-7

【Textbook(supplemental)】

【Prerequisite(s)】Logic circuits

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/ca1.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】1st term 【Class day & Period】 【Location】 【Credits】2

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

91020

Compilers

コンパイラ

【Code】91020 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90230

Information Theory

情報理論

【Code】90230 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Instructor】Toyoaki Nishida, Hisashi Kashima

【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.

【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	We briefly overview the history, goal, techniques and applications of information theory.
Source Coding and its Limitation	4	We introduce source coding, Markov sources, the source coding theorem, and entropy of information source.
Channel Coding and its Limitation	3	We elaborate on mutual information and entropy, channel capacity, maximum likelihood decoding, random coding, and the channel coding theorem.
Coding Theory	3	Following a general introduction to coding theory, we describe parity codes, Hamming codes, cyclic codes, and BCH codes.
Analogue Sources	3	We outline Fourier series, Fourier transform, the sampling theorem, and analogue sources.
Conclusion	1	We reinforce the major issues in information theory.

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

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91090

Computer Networks

コンピュータネットワーク

【Code】91090 【Course Year】 【Term】1st term 【Class day & Period】 【Location】Engineering Science Depts Bldg.-313 【Credits】2 【Restriction】No Restriction

【Lecture Form(s)】Lecture 【Language】 【Instructor】Yasuo Okabe

【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 reports, and partially on the attendance.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Ubiquitous network sociaety and computer networks	1	-ubiquitous network society and computer networks -examples of network services
Network architecture	1	-packet switching -the OSI reference model -the hierarchical model in the Internet
Application layer	1	-electric mail -WWW (the World Wide Web) -applications of WWW: multimedia communication like video streaming -Domain Name System
Transport layer	1	-port number -UDP (User Datagram Protocol) -TCP (Transmission Control Protocol) -Flow control -Congestion control
Network layer	1	-IP (Internet Protocol) -IP address -Routing algorithms -ARP (Address resolution protocol) -ICMP (Internet Control Message Protocol) -DHCP (Dynamic Host Configuration Protocol)
Data-link layer	1	-fundamentals of the data-link layer -controlling data links -synchronization -error detection and correction
Local area network	1	-LAN (Local Area Network) -VLAN (Virtual LAN) -Media Access Control (MAC) -architecture of LAN -connecting LANs
Wide area network	1	-WAN (Wide Area Networks) -protocols for WAN -access lines -VPN (Virtual Private Networks) -Wide-area Ethernet
Physical layer	1	-media -encoding -transmission
Wireless and mobile networks	1	-Wireless and microwave -wireless data links -wireless network
Visions for the future networks	5	-IPv6 -Network security -Open source softwares -Cloud computing -Business intelligence

【Textbook】Norio Shiratori (ed.): Information Network (Kyoritsu)

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90300

Graph Theory

グラフ理論

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

【Lecture Form(s)】Lecture 【Language】 【Instructor】Shuichi Miyazaki

【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. Exercises and discussions in 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 algorithm	3	I explain definition of graphs and basic properties of graphs. I also briefly review the basics of algorithms and their complexity.
Minimum spanning trees	2	Kruskal's algorithm, Prim's algorithm, Steiner tree problem.
Shortest path problems	1	Dijkstra's algorithm
Hamilton circuit problem	2	Hamilton cycle, Euler cycle, Dirac's theorem.
Coloring problems	2	Vertex coloring, edge coloring.
Maximum flow problems	2	Ford-Fulkerson's algorithm.
Matching	2	Hall's theorem, Hungarian method.
Exam	1	

【Textbook】No specification.

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

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90301

Graph Theory

グラフ理論

【Code】90301 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90250

Numerical Analysis

数値解析

【Code】90250 【Course Year】 【Term】2nd term 【Class day & Period】

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

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	6	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

20600

Applied Mathematics A2

工業数学 A2

【Code】20600 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Nakamura Yoshimasa

【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.

【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, the power method and the inverse iteration, the QR method and the divide & conquer method with the Householder transformations for preprocessing
matrix singular value decomposition	1	computation of matrix singular value decomposition (SVD) by the QR method
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

【Textbook】"Numerical Computation" (in Japanese) by H. Sunouchi and E. Ishiwata, SAIENSU-SHA

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

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

【Web Sites】

【Additional Information】

20700

Applied Mathematics A3

工業数学 A3

【Code】20700 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】The theory of Fourier analysis

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

【Course Goals】To understand fundamental theory of Fourier and Laplace analysis with a skill for evaluation of specific examples and applications in applied mathematics and physics.

【Course Topics】

Theme	Class number of times	Description
Fourier series	4-5	Introduction of the Fourier series for periodic functions. Best approximation property and the convergence of this series are shown. Discrete Fourier transform is also discussed.
Applications of Fourier series	3-4	Application of Fourier series to differential equations
Fourier transform	3-4	Introduction of the Fourier transform for L^2 functions. Invertibility of this transform and the convolution theorem are shown.
Applications of Fourier transform related	2-3	Application of Fourier series to differential equations. The relationship with Fourier transform and Laplace transform.
Summary and assessment	1	Summary and supplement of this course. Measure the progress of students in acquiring knowledge and skills.

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

【Textbook(supplemental)】S. Oishi: Fourier analysis, Iwanami shoten

【Prerequisite(s)】Calculus, Linear algebra

【Web Sites】http://www-is.amp.i.kyoto-u.ac.jp/lab/tujimoto/amathA3/

【Additional Information】

90720

Linear Control Theory

線形制御理論

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

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Masaaki Nagahara

【Course Description】In this course, we will learn the basics of feedback control theory which has its origin in the governor By James Watt (1788) and the feedback amplifier by Harold Black (1927). 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 A1 (20500) before taking this course.

【Web Sites】

【Additional Information】

90280

Probability and Statistics

確率と統計

【Code】90280 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Toshiyuki TANAKA

【Course Description】After summarizing basics of probability theory and statistics, various concepts and methods of modern statistics on the basis of probability theory and statistics, in particular multivariate regression analysis and statistical hypothesis testing, are described. Applications of these concepts and methods to data analysis are also reviewed.

【Grading】Grading is done on the basis of contents of reports submitted and results of written end-term examination.

【Course Goals】Course goals are to master basics of probability theory and statistics, and to understand how statistical methods such as multivariate regression analysis and principal component analysis are used in practice, including their theoretical backgrounds. Deepening understanding of practical applications is also expected.

【Course Topics】

Theme	Class number of times	Description
Basics of probability theory and statistics	4	Following items are described. In probability theory: Probability space, density functions, characteristic functions, expectation, covariance, correlation coefficient, Gaussian distribution, chi-squared distribution, transformation of random variables, multivariate Gaussian distribution, central limit theorem, law of large numbers. In statistics: Procedures of statistical testing, estimation of mean and variance, test on mean, test on variance, test on ratio of variances.
Multivariate regression analysis, principal component analysis	4	Describes mean-squared error estimation of regression coefficients in multivariate regression, tests on regression coefficients and regression formula, and partial correlation coefficients. Principal component analysis and its applications are also described.
Statistical testing, parameter estimation	4	Describes likelihood ratio test derived from Bayesian framework and Nayman-Pearson lemma under the framework of statistical decision theory and reviews properties of operating characteristic curve and uniformly most powerful test. Also describes maximum likelihood estimation and Bayesian estimation for parameter estimation methods.
Statistical learning theory, data analysis	3	Describes statistical learning theory, which is important as a basis for modern applications of statistics to various field. Also reviews practical applications to problems of data analysis.

【Textbook】Printed materials are distributed if appropriate.

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

【Prerequisite(s)】Students are expected to have taken Probability Theory, Mathematical Statistics, Linear Algebra A, and Linear Algebra B in the Liberal Arts and General Education Courses.

【Web Sites】

【Additional Information】Course topics would be subject to change according to levels of understanding of students.

90960

Stochastic Discrete Event Systems

確率離散事象論

【Code】90960 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Yutaka Takahashi

【Course Description】This course covers fundamental modeling and analysis methodologies to mathematically treat queueing phenomena arising in our daily life. Queues are observed when congestion occurs in those systems such as service facilities (banks, supermarkets, etc.), transportation systems, as well as communication networks/the Internet. Foundamentals of queueing theory and traffic theory are the main part of this course.

【Grading】Grading is based on the scores of the term examination and homeworks.

【Course Goals】Mastering the fundamentals of performance modeling and analysis and acquiring how to apply them for various types of systems.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Queueing model is introduced and its usefulness to mathematically describe the stochastic behaviors of discrete event systems is demonstrated. Applications of queueing theory are also shown. As a whole, the overview of the lecture is given.
Preliminaries	1～2	Probability distributions such as Poisson, exponential, Erlang, hyper distributions and some others and related stochastic characteristics are presented. Poisson process is also described in detail.
Discrete-time Markov chain	2～3	Discrete-time Markov chain is covered. Topics include state transition probability, steady state probability, recurrence time and others.
Continuous-time Markov chain	2～3	Continuous-time Markov chain is taught. In particular, birth-and-death process is described in depth. Steady-state equation and state transition diagram are explained and the condition for the existance of steady-state is clarified. Steady-state probability distribution is also derived.
Birth-and-death type queueing models	2～3	Some basic queueing models such as M/M/1, M/M/c, M/M/ ∞ , M/M/1/K, M/M/c/c etc. are analyzed to derive probability distributions of waiting time and queue length.
More general queueing models	4～5	More general queueing models such as M/G/1, M/G/1/K, and GI/M/1 are treated. The level of attainment is checked at the end of the course.

【Textbook】Handouts are provided.

【Textbook(supplemental)】One of recommended textbooks is L. Kleinrock, Queueing Systems vol.I, John Wiley and Sons .

【Prerequisite(s)】Some background on related topics such as Probability, Stochastic Process will be helpful to learn the course but it is not prerequisite. The course is managed to for students to attend without the background.

【Web Sites】

【Additional Information】

90310

Applied Algebra

応用代数学

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

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

【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】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】This lecture introduces basic technologies of artificial intelligence. Topics will be selected from search, knowledge representation, and learning.

【Grading】By reports and a final examination.

【Course Goals】Learning the concept of artificial intelligence and the basic models and algorithms of search, knowledge representation, and learning.

【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. It comes with exercise. Applications of search techniques such as computer chess, Sudoku, are also introduced.
Knowledge representation	4-5	Introducing semantic network, production system, Bayesian network, predicate logic, etc. It comes with exercise. Applications of knowledge representation techniques such as semantic web are also introduced.
Learning	5-6	Introducing decision tree learning, perceptron, SVM, genetic algorithm, reinforcement learning, etc. It comes with exercise. Applications of machine learning techniques such as data mining 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 .
M. Ginsberg, Essentials of Artificial Intelligence, Morgan Kaufmann, 1993 .
P.H. Winston, Artificial Intelligence, Addison-Wesley, 1992 .

【Prerequisite(s)】

【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】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】Toru Ishida, Naomi Yamashita

【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.
User model	2-3	Introducing user models which create human computer interfaces for supporting communication and collaboration. Explaining the affect of interfaces to users' behavior.
Usability analysis	3-4	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	2-3	Introducing the process of interaction design. The comparison between interaction design and software design is explained.
Achievement level check	1	Checking the achievement level.

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

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90920

Exercise on Numerical Analysis

数値計算演習

【Code】90920 【Course Year】3rd year 【Term】1st term 【Class day & Period】【Location】【Credits】2 【Restriction】【Lecture Form(s)】Seminar 【Language】 【Instructor】Kenji Harada, Akihiro Sato, Kinji Kimura, Hidemi Fukuda,

【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 your report	1	We will study how to write an efficient report.
Monte Carlo method	7	We will study the basic of Monte Carlo method which is a statistical method for simulating complex systems. (a) Principle of Monte Carlo Method, (b) Metropolis algorithm.
Parallelization of conjugate gradient method	7	It is the aim of this term to learn the methods for solving the linear equations of sparse matrices and implement parallel computing codes of the methods. (a) The conjugate gradient method for solving linear equations of sparse symmetric positive definite matrices, (b) The BiCG method for solving linear equations of sparse non-symmetric matrices.
Numerical method for data analysis	6	We will study fundamental methods which we need in data analysis. (a) Statistical hypothesis test, (b) Regression analysis.
Nonlinear optimization	6	We will study important methods of nonlinear optimization in the finite-dimensional vector space. (a) Steepest descent method, (b) Newton method.
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]「HANPUKUHO NO SURI」（Author:Masaaki Sugihara and Kazuo Murota，Iwanami）

【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.

【Web Sites】

【Additional Information】We will open our computer room as a study hall at the third and fourth period on Tuesday.

90740

Seminar on Applied Mathematics and Physics

数理工学セミナー

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

【Restriction】 【Lecture Form(s)】 【Language】

【Instructor】Masuyama, T.Hayashi, Ooki, M.Kaneko, K.Hayashi, Harada, Kamioka, A.Sato, Tutu, , , , , , , ,

【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)】

【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.

90930

System Analysis Laboratory

システム工学実験

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

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】M. Ozeki, K. Ohki, K. Niino

【Course Description】Our course aims at learning (1) modeling, (2) analysis (3) control of systems through the numerical computation and demonstration of the following three subjects. The students can participate in all of three subjects.

【Grading】Attendance and Report for each subject, and Attitude, behavior as individuals and as a group.

【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	10	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
Control in frequency domain	10	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 softwares, MATLAB/SIMULINK.
Inverted Pendulum	10	1. Mechanical model of 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 softwares, MATLAB/SIMULINK

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

【Textbook(supplemental)】

【Prerequisite(s)】

【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】1st term 【Class day & Period】 【Location】 【Credits】4

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】, , , , , ,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【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】2nd term 【Class day & Period】 【Location】 【Credits】3

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】, , , , , , , , , , ,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90940

Statistical Physics

物理統計学

【Code】90940 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Akito. Igarashi

【Course Description】Probability theory, statistical mechanics, and theory of stochastic process are explained as methods to investigate systems with many degrees of freedom generally. Technics for describing phase transition, 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 and entropy	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 walk	3	Stochastic process, especially Markov process is explained. As examples, Gauss process, Poisson process, Wiener process and random walks are explained.
Langevin equaitons and Fokker-Plandk 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 are explained.
Some topics for nonequiliburium system	2	We explain some topics chosen from entropy production in relaxation processes to equilibrium states from nonequiliburium states, linear responce theory, fluctuation theory, thermal excitation and diffusion and so on.

【Textbook】None

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

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

【Web Sites】

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

90830

Mechanics of Continuous Media

連続体力学

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

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Funakoshi Mitsuaki

【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	
feedback	1	

【Textbook】No

【Textbook(supplemental)】Introduced in the lecture

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

【Web Sites】

【Additional Information】

90580

Modern Control Theory

現代制御論

【Code】90580 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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
Overview of modern control theory	3	We review the history of control, and the historical background of how and why modern control theory has been developed. The importance, effectiveness and characteristics of this theory will also be discussed.
State space model and linear dynamical system	2	We discuss some fundamental properties of systems described by state space equations. In particular, basic properties of linear dynamical systems and system equivalence are also discussed.
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, and investigate its relationship with controllability, observability, and pole allocation.
Realization problem	2	We introduce the realization problem that constructs state space representations from transfer functions for single-input and single-output systems.
State feedback and dynamic compensators	2	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.
Final check of students' achievement	1	Final examination.

【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.

【Web Sites】

【Additional Information】

90790

Optimization

最適化

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

【Instructor】H. Nagamichi, N. Yamashita, L. Zhao, ,

【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.

【Web Sites】

【Additional Information】

91230

Nonliner Dynamics

非線形動力学

【Code】91230 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	3	
	3	
	2	
	4	
	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】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】Methodologies and techniques for performance evaluation of information systems aiming for their optimal design are covered in the lecture.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Outline of Information Systems	1~2	The overview of networking architectures is given, and the significance of optimal design of network systems is discussed.
Introduction to Performance Evaluation	3~4	The objectives and methods of the performance evaluation of information network systems are presented and basic performance measures are introduced.
Elements of Traffic Theory	3~4	The elements of traffic theory (including generating function methods, stochastic inequalities, and Markov chains, etc.) are delivered.
Performance Analysis of Information Systems	6~7	The analytical methods for the performance evaluation of information systems (such as priority queues, processor-sharing queues, etc.), and some general formulas for performance are discussed.

【Textbook】Printed materials are given in the lecture.

【Textbook(supplemental)】D. Bertsekas and R. Gallager, Data Networks 2nd Ed., Prentice-Hall, 1992 .
L. Kleinrock, Queueing Systems Vol.2, John Wiley and Sons, 1976 .

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

【Web Sites】

【Additional Information】

90490

Computer Architecture 2

計算機アーキテクチャ 2

【Code】90490 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn pipeline processing and storage hierarchy in computers. We also learn secondary storage devices and peripheral devices as well as multi-processor systems and computer clusters.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

【Course Goals】1. Understanding pipepline processing in computers and being able to explain it.
2. Understanding storage hierarchy in computers, and being able to explain it.
3. Understanding basics of secondary storage devices and peripheral devices, and being able to explain them.
4. Understanding basics of multi-processor systems and computer clusters, and being able to explain them.

【Course Topics】

Theme	Class number of times	Description
Pipeline processing	5	Basic concepts of pipeline processing, pipelining of data paths, data hazards, branch hazards, more sophisticated pipeline processing, etc.
Storage hierarchy	5	Basic concepts of storage hierarchy, caches, virtual store, etc.
Secondary storage devices and peripheral devices	2	Secondary storage devices such as hard discs, bus and interface between CPU/memory and peripherals, etc.
Multi-processors and clusters	2	Multi-processor systems and computer clusters
review	1	

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 4th ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP
No. 1: ISBN 978-4-8222-8478-7
No. 2: ISBN 978-4-8222-8479-4

【Textbook(supplemental)】

【Prerequisite(s)】Computer Architecture 1

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/ca2.html

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

91030

Operating System

オペレーティングシステム

【Code】91030 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

91220

Pattern Recognition

パターン認識と機械学習

【Code】91220 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】
【Instructor】Akihiro Yamamoto, Tatsuya Kawahara
【Course Description】This course provides foundations of Pattern Recognition and Machine Learning and includes exercises with some Machine Learning systems. Their applications to Artificial Intelligence, Intelligent Media Processing, and Processing large scale data are also provided.
【Grading】The grading is based on the examination following the course, and some home-works provided in the course.
【Course Goals】The course aims at making students acquire foundations of Pattern Recognition and Machine Learning and understand data driven computing. The exercises are for students to ensure the contents and to making use of them.
【Course Topics】

Theme	Class number of times	Description
Pattern Recognition (Kawahara)	7	What is Pattern Recognition?: feature vectors and feature spaces, prototypes and the nearest neighborhood method Discriminant Functions: linear discriminant functions, piece-wise linear discriminant function, quadratic discriminant functions, over-fitting Statistical Learning : Bayes decision, loss function, maximum likelihood estimation, normal distribution, parametric learning Discriminative Learning: Non- parametric learning, perceptrons, neural networks, Support Vector Machines Feature Extraction: feature normalization, KL expansion, principal component analysis, discriminant analysis
Machine Learning (Yamamoto)	7	Machine Learning from Discrete Data : Decision Tree, Bag of words, N-gram Model Distance and Clastering : hierarchical clustering, distances between discrete data, the k-means method, the EM algorithm Validation and Evaluation: cross validation, ROC, precision and recall Association Rules : the Apri-ori algorithm, maximal frequent item sets, the FP-growth algorithm (a divide-and-conquer algorithm), closed item sets Learning from Various Types of Data : finding frequent substrings, teating tree structure
Excersises (Yamamoto)	1	Excersises

【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)） ,
The Top Ten Algorithms in Data Mining (Xindong Wu and Vipin Kumar, Chapman and Hall/CRC)
【Prerequisite(s)】Artificial Intelligence, Mathematical Analysis, Linear Algebra, Probability and Statistics, Information Theory
【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】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】Raghu Ramakrishnan and Johannes Gehrke-- Database Management Systems, 3rd edition, McGraw-Hill, 2002.

【Textbook(supplemental)】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)】

【Web Sites】

【Additional Information】

91100

Introduction to Integrated System Engineering

集積システム入門

【Code】91100 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】K. Takagi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Structure of logic circuits	2 ～ 3	
Estimating propagation delay	3 ～ 4	
Power consumption and low-power design	2	
SPICE lab exercise	4	
System LSI design	1 ～ 2	
Review	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90540

Reading and Writing Scientific English

技術英語

【Code】90540 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】【Language】【Instructor】K. Takagi, A. Nakazawa, M. Cuturi

【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 score of final examination.

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

【Course Topics】

Theme	Class number of times	Description
English writing	5	Reading and writing articles on information science and technology in English
Technical presentation	5	Learn basic / technical presentation skills in English.
English reading	5	Learn reading English technical documents.

【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】2nd term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【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】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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	1	
Turing machines	4	Basic properites of Turing machites including their computation power and several equivalent machines.
Decidability and Undecidability	4	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】

90660

Image Processing

画像処理論

【Code】90660 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Instructor】Michihiko MINOH, Masayuki MUKUNOKI

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90990

Software Engineering

ソフトウェア工学

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

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

【Instructor】Akihiro Yamamoto, Hiroshi Hoshino

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】ソフトウェア工学入門 (鯵坂恒夫著，サイエンス社)

【Textbook(supplemental)】Ian Sommerville: ""Software Engineering 8th Edition"",Addison-Wesley, ISBN 0321313798, 2006 .

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91120

Multimedia

マルチメディア

【Code】91120 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

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

【Instructor】, , Michihiko MINOH, Tatsuya KAWAHARA, Masayuki MUKUNOKI

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90860

Computation and Logic

計算と論理

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

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91190

Bioinformatics

生命情報学

【Code】91190 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】, T. Kumada, T. Akutsu

【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	1	
Overview of bioinformatics	1	
Sequence analysis	1	
Inference of phylogenetic trees	2	
Hidden Markov models	2	
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.

【Web Sites】

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

91200

Mathematics of Information and Communication

情報と通信の数理

【Code】91200 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】,

【Course Description】Describes basics of "Shannon theory," which provides a solid mathematical framework for quantitatively understanding and dealing with "information" (reduction of uncertainty) and "communication" (relationship between uncertainties). Advanced topics such as rate-distortion theory and network information theory will be reviewed as well.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction / Basic concepts	5	An overview of the whole course is followed by introduction of basic information measures such as entropy, relative entropy, and mutual information. Asymptotic equipartition property and entropy rate of Markov chains are also described.
Data compression	3	The problem of data compression can be reduced to that of how to provide to random variables a description whose length is short on average. Average description length of given random variables, as well as its relation with entropy, is discussed.
Channel capacity	2	One of the most profound results of Shannon theory is channel coding theorem, which states that it is possible to transmit information over a noisy channel with a vanishing amount of errors. Channel capacity, which is a measure of information transmission ability of a given channel, is introduced, and theoretical limit of communication is argued.
Information theory for continuous-valued random variables	2	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.
Advanced topics	2	Some advanced topics such as rate-distortion theory, Kolmogorov complexity, and network information theory will be discussed.
Check of achievement	1	

【Textbook】T. M. Cover and J. A. Thomas, Elements of Information Theory, 2nd ed., Wiley-Interscience, 2006 .

【Textbook(supplemental)】

【Prerequisite(s)】Assumes basic knowledge of probability 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】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【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】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Y. Kai

【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 and risk management. 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】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

21050

Engineering Ethics

工学倫理

【Code】21050 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

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

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

22020

Exercise in English of Science and Technology(in English)

科学技術英語演習

【Code】22020 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】Nishi etc.

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Guidance	1	Orientation of the course.
Net Academy Lessons	2-5	
Speaking Test	6	
Discussion Classes	7-14	
Achievement Test	15	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

22110

Engineering and Ecology(in English)

工学とエコロジー (英語)

【Code】22110 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】 【Lecture Form(s)】 【Language】English 【Instructor】

【Course Description】The purpose of this course is to teach global ecological and environmental topics from an engineer viewpoint. The course especially contains such global ecological and environmental topics where engineering can provide solutions for sustainability. 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 to19 o ' clock.

The course is aimed for both Japanese and Foreign nationals.

The course starts on April 8th, 2014.

【Grading】Test, reports, laboratory performance.

【Course Goals】This course will provide tasks for engineering students to become aware of the relationships between engineering and various aspects of environmental issues. Students will also learn how to apply engineering skills to various environmental and ecological issues. The course prepares the students to be able to write engineering related ecological and environmental topics in English as well as verbally express themselves of these subjects.

【Course Topics】

Theme	Class number of times	Description
Student orientation, and Basic issues and critical thinking about the environment	1	
Environment and human population, ecosystems and communities	2	
Succession and restoration	3	
Biogeography	4	
Productivity and energy flow	5	
World food supply	6	
Effects of agriculture	7	
Basics of energy, fossil fuels	8	
Alternative - and nuclear energies and environment	9	
Water supply and use	10	
Water management, pollution and treatment	11	
Air pollution, Environmental economics	12	
Waste management, environmental planning	13	
Final test	14	

【Textbook】Botkin, Keller; Environmental Science, 8th Ed. 2012.

【Textbook(supplemental)】None

【Prerequisite(s)】Note:

-Interactive lessons (discussion), Small group working method

-This course is held in English.

【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.

22210

Engineering and Economy(in English)

工学と経済（英語）

【Code】22210 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2 【Restriction】 【Lecture Form(s)】

【Language】English 【Instructor】

【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 October 2nd.

【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	
Cost concept	2	
Design economics	3	
Cost estimation techniques I	4	
Cost estimation techniques II	5	
The time value of money I	6	
The time value of money II	7	
The time value of money III	8	
Evaluation of a single project I	9	
Evaluation of a single project II	10	
Comparison and selection among alternatives I	11	
Comparison and selection among alternatives II	12	
Income taxes and depreciation	13	
Final test	14	

【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.

【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】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【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】 【Term】 【Class day & Period】 【Location】 【Credits】1 【Restriction】

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

53000

Introduction to Elecronics

エレクトロニクス入門

【Code】53000 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	5	
	2	
	5	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

50182

Quantum Physics 1

量子物理学１

【Code】50182 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】examination

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	2	
Fundamental framework of quantum theory	3	
Quantization	2	
Particle motion in one dimension	3	
Harmonic oscillator	1	
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

【Web Sites】

【Additional Information】

50192

Quantum Physics 2

量子物理学 2

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

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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	1	
Perturbation theory (stationary method)	3	
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

【Web Sites】

【Additional Information】

60100

Electronic Circuits

電子回路

【Code】60100 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【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 in the URL of this lecture.

【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	1~2	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	1~2	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, 2008)

【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.)

【Web Sites】Link to the homepage of this course is here; (https://www.t.kyoto-u.ac.jp/lecturenotes/fe/d/60100/outline) Sorry for Japanese version only.

【Additional Information】The topics will be selected owing to limit of lecture time. The students should prepare "Bar Cover (http://www.kuee.kyoto-u.ac.jp/barcover/)" by themselves, used as a title page of each report. The homepage of this course is located in the "page of lecture materials" in the homepage of the faculty of engineering (https://www.t.kyoto-u.ac.jp/lecturenotes).

60320

Modulation Theory in Electrical Communication

通信基礎論

【Code】60320 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

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

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

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

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

工学部シラバス 2014 年度版
（[E] Informatics and Mathematical Science）
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2014 年 4 月 1 日発行（非売品）

編集者　京都大学工学部教務課
発行所　京都大学工学部
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デザイン　工学研究科附属情報センター

工学部シラバス 2014 年度版

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