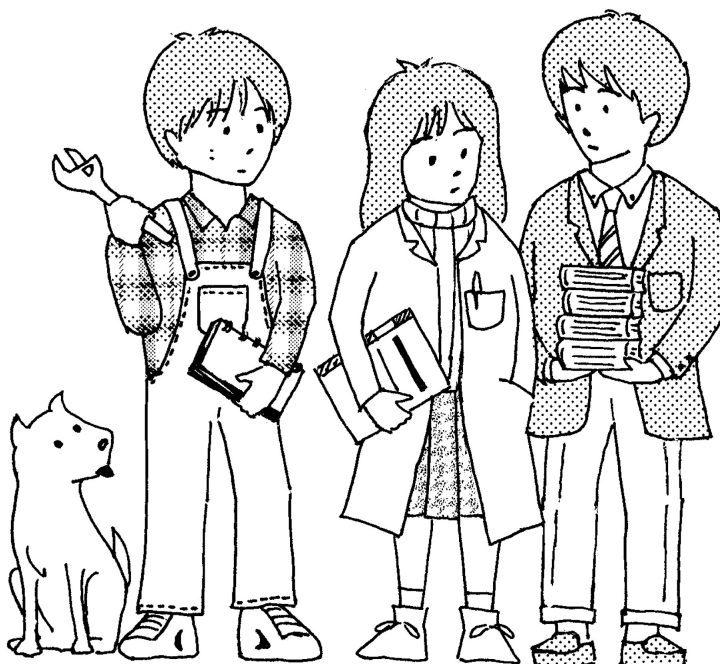# SYLLABUS 2012

[E] Informatics and Mathematical Science

Kyoto University, Faculty of Engineering

[E] Informatics and Mathematical Science

Informatics and Mathematical Science

Introduction to Computer Science

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, Kazo Iwama, Akihiro Yamamoto

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
Systems(Takagi)	5	
Algorithms(Iwama)	4-5	
Applications(Yamamoto)	4-5	
review	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Introduction to Applied Mathematics and Physics

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

Introduction to Algorithms and Data Structures

Code   91150   Course Year   Term   2nd term   Class day & Period   Location   Credits   2
Restriction   No Restriction   Lecture Form(s)   Language   Instructor   Hiroshi G. Okuno
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	2	Goals of the class History of Computers How to use JAKLD, a Java-based Scheme
Building Abstractions with Procedures	4	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)

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   Scheme implemented in Java, JAKLD is used for practice. JAKLD is available at the
Media Center. It also runs on Android.

An assignment will be given at the end of class every week. The deadline of submission is noon next Tuesday.
The report should be composed by LaTeX and submitted as a PDF file.

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.

Lecture Page .

Linear Programming

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

Restriction   No Restriction   Lecture Form(s) Lecture   Language   Instructor   M. Fukushima

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

Electric Circuits and Differential Equations

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	
	6	
	6	
	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

230114

Exercises in Information Processing Basics

Code 230114   Course Year 1st year   Term 1st term   Class day & Period   Location   Credits 2

Restriction   No Restriction   Lecture Form(s) Seminar   Language   Instructor Hattori

Course Description   Exercises for using UNIX workstation as a tool.

Grading   Evaluation based on attendance record and reports.

Course Goals   To acquire computer literacy in UNIX environment.

Course Topics

Theme	Class number of times	Description
Basics of UNIX system	2	Learn basic usage of UNIX system, including X Window, file system, commands, etc.
Shell & text editor (Emacs)	3	Learn basic usage of shell and Emacs, and write texts using them.
Security, Email, the Web	1	Learn basics of information security, how to set up and use Email clients and how to retrieve various information and data by web search engines.
LaTeX	2	Learn how to write documents by LaTeX.
Figure & graph drawing, file format conversion	3	Learn how to draw figures and graph charts by gnuplot and tgif, how to convert file formats and include them in LaTeX documents.
Programming; string processing & arithmetic calculus	1	Learn how to write programs for string processing and arithmetic calculus in AWK.
Advanced exercise	3	Advanced exercises for more understanding.

Textbook   Exercises in Information Processing Basics (sold by Kyoto Univ. Coop)(MUST)

Textbook(supplemental)

Prerequisite(s)

Web Sites   http://www.dl.kuis.kyoto-u.ac.jp/~ohshima/kiso/

Additional Information   Exercise schedule depends on the academic calender and learning level. As the background knowledge of Introduction to Algorithms and Data Structures (91150) and Hardware and Software Laboratory Project 1 (90210), taking this course is strongly recommended. Prepare the textbook and ECS-ID (issued by The Institute for Information Management and Communication (IIMC) of Kyoto University) in advance. Take the e-Learning on information security.

230115

Exercises in Information Processing Basics

Code   230115   Course Year   1st year   Term   1st term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Seminar   Language   Instructor   Ohshima

Course Description   Exercises for using unix workstation as a tool.

Grading   Evaluation based on attendance record and reports.

Course Goals   To acquire computer literacy in unix environment.

Course Topics

Theme	Class number of times	Description
Basics of UNIX system	2	Learn basic usage of UNIX system, including X Window, file system, commands, etc.
Shell & text editor (Emacs)	3	Learn basic usage of shell and Emacs, and write texts using them.
Security, Email, the Web	1	Learn basics of information security, how to set up and use Email clients and how to retrieve various information and data by web search engines.
LaTeX	2	Learn how to write documents by LaTeX.
Figure & graph drawing, file format conversion	3	Learn how to draw figures and graph charts by gnuplot and tgif, how to convert file formats and include them in LaTeX documents.
Programming; string processing & arithmetic calculus	1	Learn how to write programs for string processing and arithmetic calculus in AWK.
Advanced exercise	3	Advanced exercises for more understanding.

Textbook   Exercises in Information Processing Basics (sold by Kyoto Univ. Coop)(MUST)

Textbook(supplemental)

Prerequisite(s)

Web Sites   http://www.dl.kuis.kyoto-u.ac.jp/~ohshima/kiso/

Additional Information   Exercise schedule depends on the academic calender and learning level. As the background knowledge of Introduction to Algorithms and Data Structures (91150) and Hardware and Software Laboratory Project 1 (90210), taking this course is strongly recommended. Prepare the textbook and ECS-ID (issued by The Institute for Information Management and Communication (IIMC) of Kyoto University) in advance. Take the e-Learning on information security.

20500

Applied Mathematics A1

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

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	4	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	3	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	2	The calculus of residues is dealt with. Examples are given of integral evaluations.

Textbook

Textbook(supplemental)   Advanced engineering mathematics (Japanese translation), E. Kreyszig ,

Prerequisite(s)   Calculus, Linear algebra

Web Sites

Additional Information

Dynamics of Particles and Vibration

Code   90680   Course Year   2nd year   Term   1st term   Class day & Period   Location   Credits   2

Restriction   Lecture Form(s)   Lecture   Language   Instructor   Miyazaki, Syuji

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

Applied Mathematics and Physics Laboratory

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
	6	
	6	
	6	
	6	
	6	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Exercise on Applied Mathematics and Physics

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	
	4	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90910

Exercise on Programming

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
	9.5	
	1.5	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Hardware and Software Laboratory Project 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

Hardware and Software Laboratory Project 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

Introduction to Systems Analysis

Code   90070   Course Year   2nd year   Term   1st term   Class day & Period

Location   Integrated Research Bldg.-213   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	1	Overview of the course.
Dynamical systems	3	Examples of dynamical systems such as mechanical systems, electrical systems, chemical processes, and biological systems.
Linear dynamical systems	2	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	2	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.
Feedback systems	2	Feedback connection of linear systems.
Discrete-time systems	3	Discrete-time systems described by difference equations.

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

Logical Systems

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

Introduction to Dynamical Systems

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?	2	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	1	Why we formulate models in terms of differential equations?
Exponential function	2	Definition and properties of exponential function.
Basic method for solving differential equations	2	Linear differential equations.
Qualitative analysis	3	Phase flow, phase diagram, stability, Lyapunov function, linearized approximation, limit cycle.
Number and quanitity	2	Dimensional analysis, tensor algebra.
Applications	2	Equations of motion, models of rocket, planet, ecology.

Textbook

Textbook(supplemental)

Prerequisite(s)   These lectures are given in Japanese.

Web Sites

Additional Information

Analytical Dynamics

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
	7	
	4	
	4	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Logic Circuits

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. 314, Engineering Building #10
Email:takagi@i.kyoto-u.ac.jp

Languages and Automata

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

Computer Architecture 1

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	
Instruction set architecture	5	
Computer arithmetic	3	
Design of simple processors	4	
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. 314, Engineering Building #10

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

Programming Languages

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	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Compilers

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

Information Theory

Code   90230   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
	1	
	4	
	3	
	3	
	3	
	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Computer Networks

Code 91090   Course Year   Term 1st term   Class day & Period   Location   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

Graph Theory

Code 90300   Course Year   Term 2nd 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
What are graphs?	2 3	
Shortest path problems	1	
Coloring problems	2	
Maximum flow problems	1	
Np-complete problems	1 2	
The maximum matching problems	1	
Connectivity of graphs	1 2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Graph Theory

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	
	1	
	1	
	2	
	2	
	1	
	2	
	1　　2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Numerical Analysis

Code   90250   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

Applied Mathematics A2

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   Iwai, Toshihiro

Course Description   Applied Mathematics A1 is prerequisite to this course. Systems of linear differential equations with constant coefficients are dealt with on the basis of the theory of functions of one complex variables along with applications. The Cauchy theorem for the existence and uniqueness of ordinary differential equations is proved together with applications.

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

Course Goals   Since ordinary differential equations with constant coefficients are basic in a variety of fields in engineering, understanding both the theory and practical methods for solutions is an important goal of this course.

Course Topics

Theme	Class number of times	Description
Ordinary linear differential equtions woith	2	On the basis of the theory of functions of one complex variable, ordinary linear differential equations with constant coefficients are discussed in association with the method of Laplace transformation.
Calculus of matrices with a complex parameter	3	Calculus for matrices with a complex parameter is given in the scope of applications to differential equations. The exponential functions of matrices are treated in this calculus.
Linear equation with constant coefficients	2	Solutions to systems of linear differential equations with constant coefficients are given on the basis of calculus of matrices with a complex parameter.
Existence and uniqueness of a solution	3 4	The Cauchy theorem for the existence and uniqueness of a solution to a differential equation is proved. This theorem is shown to be effective in the study of the Jacobi elliptic functions.
Solutions to linear equations	2	The space of solutions to a homogeneous linear equation is shown to form a vector space. And fundamental matrices and Wronskian are described.
Dependence on paremeters	2	The parameter dependence of solutions are discussed; solutions depend on parameters in continuous or differentiable manner.

Textbook

Textbook(supplemental)   H. Ito; Ordinary differential equations and analytic mechanics (Japanese) , N. Shimakura; Ordinary differential equations (Japanese)

Prerequisite(s)   Calculus A, B, Advanced calculus A, Linear algebra, Applied Mathematics A1

Web Sites

Additional Information

Applied Mathematics A3

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

Additional Information

Linear Control Theory

Code   90720   Course Year   3rd year   Term   1st term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Lecture   Language   Instructor   Kiyotsugu Takaba

Course Description   In this course, we will study the basics in the feedback control theory such as control system analysis in the time- and frequency-domains, stability, and servo mechanism design, etc.

Grading   The final grade in this course is based on your scores in the mid-term and final examinations.

Course Goals   The goal of this course is to understand the basics on the analysis of feedback systems and to acquire the frequency-domain method 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   T. Katayama: Fundamentals of Feedback Control: New edition (in Japanese). Asakura Publisher, 2002

Textbook(supplemental)

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

Probability and Statistics

Code 90280   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
	3-4	
	4	
	4	
	3	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Stochastic Discrete Event Systems

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. Fundamentals 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		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		Discrete-time Markov chain is covered. Topics include state transition probability, steady state probability, recurrence time and others.
Continuous-time Markov chain		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		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		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

Applied Algebra

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

Additional Information

Artificial Intelligence

Code   91160   Course Year   3rd year   Term   1st term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Lecture   Language   Instructor

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

Human Interface

Code 91170   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
	1	
	3	
	4	
	4	
	3	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Exercise on Numerical Analysis

Code 90920   Course Year 3rd year   Term 1st term   Class day & Period   Location   Credits 2

Restriction   Lecture Form(s) Seminar   Language   Instructor   Harada, Kimura, Sato, Yamaguchi

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
Guidance	1	
How to write your report	1	
Mente Carlo method	7	
LU decomposition and parallel computation	7	
Numerical integration of dynamical systems	7	
Stochastic differential equations	7	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90740

Seminar on Applied Mathematics and Physics

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

Restriction   Lecture Form(s)   Language

Instructor   A.Igarashi, Masuyama, Fukunaga, Ohkubo, Yamaguchi, Harada, Y.Kaneko, 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.

System Analysis Laboratory

Code   90930   Course Year   3rd 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	
	14	
	14	
	14	
	14	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Hardware and Software Laboratory Project 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

Hardware and Software Laboratory Project 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

Statistical Physics

Code 90940   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
	3	
	2	
	2	
	2	
	2	
	2	
	2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Mechanics of Continuous Media

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	
examination	1	

Textbook   No

Textbook(supplemental)   Introduced in the lecture

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

Web Sites

Additional Information

Modern Control Theory

Code   90580   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
	1	
	2	
	3	
	1	
	2	
	3	
	3	
	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Optimization

Code   90790   Course Year   3rd year   Term   2nd term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Lecture   Language

Instructor   M. Fukushima, 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

Mathematical Physics in Nonequilibrium Systems

Code 90950   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
What is nonequilibrium system?	3	
Probabilistic aspects in nonequilibrium systems	2	
Dynamical descriptions of nonequilibrium systems	3	
Chaos and fractal	2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Theory of Information Systems

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   For optimal design of computer/communication networks, modeling techniques and methods of performance evaluation based on queueing theory and Monte Carlo simulation are covered in the lecture.

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
Computer/communication network system		Overview of circuit switching networks and packet transport network is given, and the significance of optimal design of network systems is discussed.
Introduction to performance evaluation		The objective of performance evaluation of computer/communication networks, performance measures, and the methods of performance evaluation are introduced.
Performance evaluation based on queueing theory		Queueing theory including priority queueing, queueing network, and approximation methods are explained. The significance of quantitative analysis is discussed with the performance comparison of basic queueing systems.
Monte Carlo simulation		Monte Carlo simulation basics are introduced. Topics includes methods of pseudo random number generation, confidence interval, and steady-state simulation.
Performance evaluation of network systems		Performance analysis of automatic repeat request (ARQ) protocols is explained. Achievement is evaluated at the last lecture.

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

Computer Architecture 2

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.

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.

Course Topics

Theme	Class number of times	Description
Pipeline processing	5-6	Basic concepts of pipeline processing, pipelining of data paths, data hazards, branch hazards, more sophisticated pipeline processing, etc.
Storage hierarchy	6-7	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.
review	1	

Textbook Computer Organization and Design - The Hardware/Software Interface - 3rd ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP No. 2: ISBN 978-4-8222-8267-7

Textbook(supplemental) Computer Organization and Design - The Hardware/Software Interface - 3rd ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP No. 2: ISBN 978-4-8222-8267-7

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. 314, Engineering Building #10

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

Operating System

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Pattern Recognition

Code   91220   Course Year   3rd year   Term   2nd term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Lecture   Language   Instructor

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 and Data Mining : Formal Definition of Machine Learning(positive data, negative data, representation of rules, Search spaces), Data Mining Association Rules : Content-based filtering, the Apri-ori algorithm, maximal frequent item sets, The FP-growth algorithm (a divide-and-conquer algorithm) Clustering : hierarchical clustering, distances between data Optimization and Machine Learning : the k-means method, the EM algorithm Validation and Evaluation: cross validation, ROC, precision and recall Learning Bayesian Networks : learning structures, , the K-2 algorithm
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) ,

(   )   ,

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.

Databases

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
	3	
	4	
	3	
	2-3	
	1-2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Introduction to Integrated System Engineering

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

Restriction   Lecture Form(s)   Language   Instructor H. Ochi and K. Takagi

Course Description

Grading

Course Goals

Course Topics

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Reading and Writing Scientific English

Code   90540   Course Year   3rd year   Term   1st term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Language   Instructor

Course Description   This lecture provides knowledge for reading and writing technical articles(e.g., theses, manuals and letters), in English using articles on information science and technology as materials.

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 reading and writing	14	Reading and writing articles on information science and technology in English

Textbook   We will deliver supplemental materials in classes.

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information   You are expected to attend class regularly.

91110

Information Systems

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

Theory of Algorithms

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

Code   90660   Course Year   3rd 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 2	
	4	
	4	
	4	
	1 2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Software Engineering

Code   90990   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
	1	
	1	
	1	
	2	
	2	
	1	
	3	
	1	
	2	
	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

91120

Multimedia

Code   91120   Course Year   3rd 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	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Computation and Logic

Code   90860   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

Bioinformatics

Code   91190   Course Year   3rd year   Term   2nd term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Lecture   Language   Instructor   T. Akutsu and T. Yada

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. 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
Overview of bioinformatics	1	
Sequence analysis	1	
Inference of phylogenetic trees	2	
Analysis of protein structures	1	
Scale-free networks	1	
Analysis of metabolic networks	1	
Genetic algorithms	2	
Neutral theory of molecular evolution	2	
Hidden Markov models	2	
Neural networks	2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Mathematics of Information and Communication

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

Signals and Systems

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	
	2	
	2	
	2	
	2	
	2	
	3	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Analysis in Mathematical Sciences

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

Dynamics of Nonlinear Systems

Code 91060   Course Year 4th year   Term 1st term   Class day & Period   Location   Credits 2

Restriction No Restriction   Lecture Form(s) Lecture   Language   Instructor Aki-Hiro Sato, Ken Umeno

Course Description   In the former half, fundamental theory on nonlinear dynamics and stochastic processes and Fokker-Planck equations. In the later half, the chaos important in the nonlinear dynamical systems and its applications are explained.

Grading   Evaluated according to the scores of report examinations and quizzes in class.

Course Goals   Understanding of various basic methods for the analysis of nonlinear phenomena of nonlinear dynamical systems.

Course Topics

Theme	Class number of times	Description
Fundamental theory of nonlinear dynamics	3	The fundamental theory of nonlinear dynamics (stability and bifurcation) will be explained.
Stochastic differential equations and Fokker-Planck equations	4	Stochastic differential equations and Fokker-Planck equations (FPE) will be explained. The analysis with the FPE will be applied to estimating parameters of nonlinear dynamical systems.
Fundamentals of chaos	6	It is known that evolution of nonlinear dynamical systems, even with small degrees of freedom, are sometimes quite sensitive to initial conditions and practically unpredictable. Such phenomena are called chaos. Fundamentals of chaos in one-dimensional maps and differential equations are explained. Fundamental theory of exactly solvable chaos is also explained.
Applications of chaos	2	Applications of chaos is explained with several examples such as chaotic communications systems and chaotic Monte Carlo computations.

Textbook   None

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

English for Mathematical Science

Code   90870   Course Year   2nd year   Term   2nd term   Class day & Period   Location   Credits   2

Restriction   Lecture Form(s)   Lecture   Language   Instructor   Ohta, Fujioka, Zhou

Course Description   This course aims to learn reading and writing of English for mathematical science.

Grading   Quizzes and assignments.

Course Goals   Students will learn the rudiments of reading and writing of English for mathematical science.
They will learn how to make a presentation in English.

Course Topics

Theme	Class number of times	Description
Reading	5	
Writing	5	
Presentation	5	

Textbook   K.R.Matthews, Elementary Linear Algebra. http://www.numbertheory.org/book/

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Business Mathematics

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		
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

Information and Business

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

Code 21050   Course Year 4th 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
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Introduction to Engineering

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

Exercise in English of Science and Technology

Code 22020   Course Year 2nd 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

Engineering and Ecology
(　　)

Code 22110   Course Year   Term 1st term   Class day & Period   Location   Credits 2   Restriction

Lecture Form(s)   Language   English   Instructor

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
	1	
	2	
	3	
	4~5	
	6~7	
	8~11	
	12~13	
	14~15	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Engineering and Economy

Code 22210   Course Year   Term 2nd term   Class day & Period   Location   Credits 2   Restriction

Lecture Form(s)   Language English   Instructor

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
	1~2	
	3~4	
	5~6	
	7~8	
	9~10	
	11~13	
	14~15	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Global Leadership Seminar I

Code 24010   Course Year 3rd year   Term   Class day & Period   Location   Credits 1   Restriction

Lecture Form(s)   Language   Instructor   73

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

Code 25010   Course Year 4th year   Term   Class day & Period   Location   Credits 1   Restriction

Lecture Form(s)   Language   Instructor   74

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Introduction to Elecronics

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

Quantum Physics 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   Yamamoto (K), Miyadera

Course Description

Grading   examination

Course Goals

Course Topics

Theme	Class number of times	Description
Introduction		
Basics of quantum mechanics		
Particle motion in one dimension		
Particle motion in three dimensions (1)		
Particle motion in three dimensions (2)		
Confirmation of achievement in study		

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Quantum Physics 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 Yamamoto (K), Miyadera

Course Description

Grading   examination

Course Goals

Course Topics

Theme	Class number of times	Description
Theoretical framework of quantum mechanics		
Approximation methods (stationary states)		
Approximation methods (transition problems)		
Electron and spin		
Spin and quantum statistics		
Confirmation of achievement in study		

Textbook

Textbook(supplemental)

Prerequisite(s)   Quantum Physics 1

Web Sites

Additional Information

Electronic Circuits

Code 60101   Course Year 4th year   Term 1st term   Class day & Period   Location   Credits 2

Restriction No Restriction   Lecture Form(s) Lecture   Language   Instructor

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	

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).

Modulation Theory in Electrical Communication

Code   60321   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
	3-4	
	5-6	
	4-5	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

2012

[E] Informatics and Mathematical Science

2012   4   1

606-8501

2012

[A] Global Engineering

[B] Architecture

[C] Engineering Science

[D] Electrical and Electronic Engineering

[E] Informatics and Mathematical Science

[F] Industrial Chemistry

`http://www.t.kyoto-u.ac.jp/syllabus-s/`

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