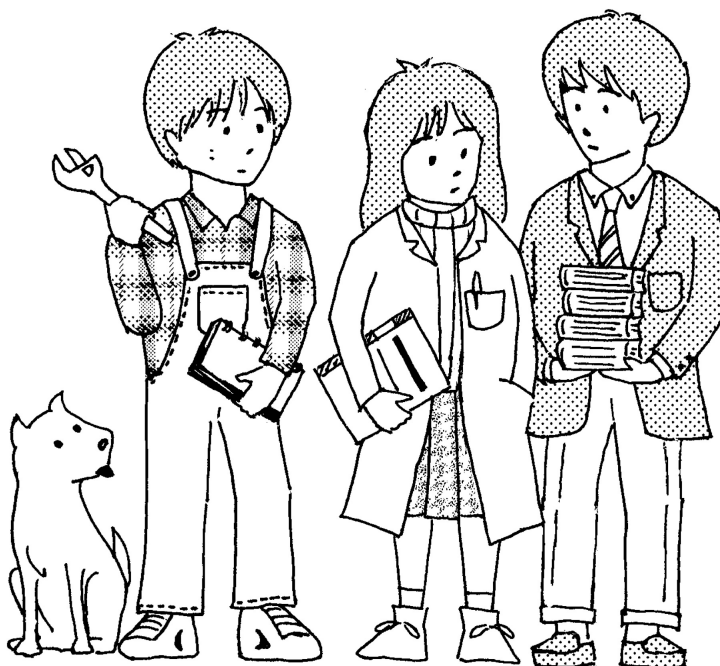# SYLLABUS 2010

[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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
Applications(Yamamoto)		
Algorithms(Iwama)		
Systems(Takagi)		

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90690

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

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.

Textbook

Textbook(supplemental) M. Fukushima, Introduction to Mathematical Programming (in japanese), Asakura Shoten.

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

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

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
Computer Literacy	15	(i) Startup of Unix workstation (ii) Usage of online manual (iii) Shell (iv) Usage of Emacs (v) Usage of Email and Web (vi) LaTeX (vii) Drawing of figure and graph

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

Textbook(supplemental)

Prerequisite(s)

Web Sites   http://www.db.soc.i.kyoto-u.ac.jp/lec/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.

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

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
Computer Literacy	15	(i) Startup of Unix workstation (ii) Usage of online manual (iii) Shell (iv) Usage of Emacs (v) Usage of Email and Web (vi) LaTeX (vii) Drawing of figure and graph

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

Textbook(supplemental)

Prerequisite(s)

Web Sites   http://www.db.soc.i.kyoto-u.ac.jp/lec/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   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

90890

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   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

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

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

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

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   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

90700

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

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

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

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	3	Equations of motion, models of rocket, planet, ecology.

Textbook

Textbook(supplemental)

Prerequisite(s)   These lectures are given in Japanese.

Web Sites   http://yang.amp.i.kyoto-u.ac.jp/~tanimura/class.html

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
	5-6	
	5-6	
	3-4	

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

Course Description

Grading

Course Goals

Course Topics

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Languages and Automata

Code 91040 Course 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	1	

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

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	
	6	

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
	2	
	4	
	3	
	3	
	2	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Computer Networks

Code 91090   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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90300

Graph Theory

Code   90300   Course Year   2nd 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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Graph Theory

Code   90301   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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90250

Numerical Analysis

Code   90250   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

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

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 functions of one complex variables along with applications. The Cauchy theorem for the existence and uniqueness of ordinary differential equations is proved 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 complex functions of one 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 application to 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 depencence 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

20700

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

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

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90310

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

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, learning, and knowledge representation.

Grading　By reports and a final examination.

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

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.
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.
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.

Textbook　Materials will be distributed.

Textbook(supplemental)　S. Russell and P. Norvig, Artificial Intelligence A Modern Approach, Prentice Hall, 1998.
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

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

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

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

90840

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
	2	
	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

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 fluid	3　4	
dynamics of inviscid fluids	1　2	
compressible fluids and sound waves	1	
basic equations in elasticity	2　3	

Textbook   No

Textbook(supplemental)   Introduced in the lecture

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

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	

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

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.

Textbook

Textbook(supplemental)   M. Fukushima, Introduction to Mathematical Programming (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?	2	
Probabilistic aspects in nonequilibrium systems	3	
Dynamical descriptions of nonequilibrium systems	2	
Chaos and fractal	7	

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

91030

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)		What is Pattern Recognition?: feature vector and feature space, prototype and nearest neighborhood
		Discriminant Function: linear discriminant function, piece-wise linear discriminant function, quadratic discriminant function, over-fitting
		Feature Extraction: feature normalization, KL expansion, principal component analysis, discriminant analysis
		Parametric Training: Bayes decision, loss function, maximum likelihood estimation, normal distribution
Discriminant Learning (Ogata)		What is Discriminant Learning?: Perceptron, Neural Network, Support Vector Machine, Learning by Evaluating Errors: Back Propagation, Widrow-Hoff learning rule, Exercise: exercises with WEKA
Machine Learning (Yamamoto)		What is Machine Learning? : Defining Machine Learning, Knowledge representation, Search space for learning Learning Association Rules : Content-based faltering, Breath-first search Algorithms, a Divide-and-conquer algorithm, Maximal frequent item sets Clustering: Hierarchical clustering, the k-Means method, distances of data Validation and Evaluation: Cross validation, ROC, False positive and false negative, Precision and recall Statistics and Machine Learning: AIC, MDL, Statistical clustering, the EM Algorithm, the K-2 Algorithm for learning Bayesian-networks

Textbook   Indicated in the Japanese page

Textbook(supplemental)   Richard O. Duda, Peter E. Hart, and David G. Stork: Pattern Classification, Wiley N.J.Nilsson, Morgan Kaufmann: Learning Machines

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

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	15	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.

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

90551

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.

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

Textbook(supplemental)

Prerequisite(s)   91040

Web Sites

Additional Information

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90860

Computation and Logic

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

Systems 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

Course Description   This course overviews mathematical models and computational methods in systems biology. In particular, this course explains how such methods as graph theory, machine learning, optimization, and nonlinear differential equations are applied to analyses of biological networks, neural networks and evolution of biological sequences. 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 systems bioinformatics	1	
Network biology	1	
Analysis of metabolic networks	1	
Analysis of gene expression data	1	
Population genetics and genetic algorithms	4 5	
Mathematical models and analyses of neural networks	2	
Phylogenetic trees	2 3	
Concluding remarks	1	

Textbook

Textbook(supplemental)

Prerequisite(s)   None

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	3	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	3	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.

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

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

Course Description   In the former half, various nonlinear behaviors of nonlinear oscillators such as bifurcation, hysteresis and chaos, and the methods for their analysis are explained. In the latter half, routes to chaos, bifurcations, and statistical properties are illustrated with one-dimensional chaotic maps. And cooperation phenomena of coupled nonlinear systems such as synchronizations 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
Behavior of nonlinear oscillators and the methods for their analysis	3-4	
Behavior of forced nonlinear oscillators and the methods for their analysis	3-4	
Bifurcation and chaos in one-dimensional maps	3-4	
Cooperation phenomena in coupled nonlinear oscillators	3-4	

Textbook   None

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

90870

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

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

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

91080

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

Code   91080   Course Year   4th year   Term   1st term   Class day & Period   Location   Credits   2

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

21010

Global Leadership (Introduction)

Code   21010   Course Year   1st year   Term   Class day & Period   Location   Credits   2

Restriction   No Restriction   Lecture Form(s)   Language   Instructor

Course Description

Grading

Course Goals

Course Topics

Theme	Class number of times	Description
	1~3	
	4	
	5~15	

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

Global Leadership (Exercise in English)

Code 22000   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

22100

Global Leadership (Engineering and Ecology)

Code   22100   Course Year   2nd year   Term   1st 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

Global Leadership (Engineering and Economy)

Code   22200   Course Year   2nd year   Term   2nd 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

24000

Global Leadership (Advanced Seminar　)

Code　24000　Course Year　3rd 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

Global Leadership (Advanced Seminar　)

Global Leadership (Advanced Seminar　)

Code　25000　Course Year　4th 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

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

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)		

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

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		

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	
Fundamentals of transistor circuits	3	
Various amplifier circuits	3	
Operational amplifiers	2	
Oscilators	2	
Others	1	

Textbook   M. Kitano, Fundamentals of Electronic Circuits (Reimei Publishing, Kyoto, 2008)

Textbook(supplemental)

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

Textbook

Textbook(supplemental)

Prerequisite(s)

Web Sites

Additional Information

2010

[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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