Course Name(科目名)	Algorithm Expression			
Instructor Name(担当教員名)	Teigo Nakamura			
Course intended for(対象学年)	1st or 2nd year student			
Credit Category(単位区分)	Elective course		Credits(単位数)	2
Course Description(授業の概要)	Understanding the representation of control structures, procedures, and data structures required by algorithms for realizing intelligent information processing, and learning various game tree search methods and methods to improve search efficiency using game programming as the target area of artificial intelligence.			
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is assumed that students have acquired basic concepts related to programming and data structures and algorithms.			
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)	
	1.	Classification of thinking games		
	2.	State space search method		
	3.	Game tree search mechanism		
	4.	Date structure of game positions		
	5.	Alpha-beta search and its efficiency		
	6.	Iterative deepening		
	7.	Game tree expansion		
	8.	Transposition table		
	9.	Window search		
	10.	Control of search space		
	11.	Proof number search		
	12.	Depth-first proof number search		
	13.	Monte Carlo tree search (1)		
	14.	Monte Carlo tree search (2)		
	15.	Final report		
General Course Policies(授業の進め方)	At first, the teacher gives lectures, and then each student gives a presentation on the tasks assigned to him/her. At the end of the semester, report assignments will be given.			
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Acquiring "basic scholastic ability required in information science / engineering and various fields" listed in the Common Learning Educational Objective (B) of the Graduate School of Computer Science and Systems Engineering.		
	Couse objectives (具体的な授業の達成目標)	1. Understanding the characteristics of various data structures for game positions.		
		2. Understanding the basic concept of game tree search and describing search algorithms.		
		3. Understanding the methods to improve search efficiency and their characteristics.		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	For each objective above, the degree of achievement is evaluated based on the results of assignment presentation status (60%) and final report (40%).			
Assignment Instructions (授業外学習(予習・復習)の指示)	As a preparatory, study four hours a week. In the presentation of the assignment, make sure to review the relevant literature and make preparations.			
Keywords(キーワード)				
Required Textbooks(教科書)	"Game Computation Mechanism", Yoshiyuki Kotani, Corona Publishing CO., LTD.			
References/Recommended Reading (参考書)				
Notes(備考)				
Email(電子メールアドレス)	teigo@ai.kyutech.ac.jp			

Course Name(科目名)	Automaton and Language Theory		
Instructor Name(担当教員名)	Hiroki Ishizaka		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	We reconsider formal language theory based on EFS (Elementary Formal System), a kind of logic program on character strings. Formal language expression systems include formal grammars and automata (Turing machines). The difference between the two is not only an expression problem, but also a functional difference in that the grammar performs language generation and the automaton performs acceptance. In EFS, these two different functions can be realized in a single representation by capturing them in the form of proofs and calculations in logic programs. Also, as a feature of the logic program, it has the flexibility to not only define individual languages, but also to naturally define relationships between languages. In this lecture, we will give an overview of how to express a language using EFS and its expressiveness, and also introduce recent topics on EFS with a focus on machine learning.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Since EFS is a logic program on character strings, it is assumed that students have completed undergraduate courses related to formal language theory and mathematical logic. Also, if you have knowledge about logic programs, you can understand them more easily.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Language, grammar, Turing machine	
	2.	EFS and EFS language	
	3.	EFS language and Chomsky hierarch	
	4.	Language acceptance by resolution p	
	5.	EFS processing system using multipl	
	6.	Translation EFS and maximally gener	
	7.	Model theory on EFS	
	8.	Machine learning	
	9.	Learning from positive data and EFS	
	10.	Theory of model inference	
	11.	Learning of one-sided linear EFS (lea	
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lectures on the above items will be the main subject, and finally a report for grade evaluation will be imposed.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. By learning about EFS, a formal expression system based on logic, and the theory of its application, one 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluate based on the content of the submitted report.
Assignment Instructions (授業外学習(予習・復習)の指示)		4 hours a week as a preparation
Keywords(キーワード)		EFS, elementary formal sysytem, formal language, automata
Required Textbooks(教科書)		Keishiki gengo no riron, T. Nshino, H. Ishizaka, Maruzen publishing
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Course in Computer Vision I		
Instructor Name(担当教員名)	Takahiro Okabe		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The aim of computer vision is to realize human visual system through computation. In this course, we study computer vision, in particular 2D image processing, image pattern recognition, and 3D image processing from their basic theories to applications.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This advanced course is related to the following ones: Advanced Course in Computer Vision II, Advanced Topics in Image Processing, Advanced Course of Digital Image Processing, Video Image Processing, Advanced Course in Pattern Understanding, Advanced Computer Graphics I, and Advanced Computer Graphics II.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Digital image	
	2.	2D image processing: color space an	
	3.	2D image processing: spatial filtering	
	4.	2D image processing: frequency filte	
	5.	2D image processing: 2D geometric t	
	6.	2D image processing: segmentation a	
	7.	Video image processing	
	8.	Image pattern recognition: basic appr	
	9.	Image pattern recognition: supervise	
	10.	3D image processing: geometric appr	
	11.	3D image processing: stereo vision	
	12.	3D image processing: photometric ap	
	13.	3D image processing: inverse renderi	
	14.	Computational photography	
	15.	Summary	
General Course Policies(授業の進め方)	In addition to a term-end examination, some short tests are conducted. The slides for the classes are		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goals of this advanced course are as follows.	
	Couse objectives (具体的な授業の達成目標)	1. Understand the basic technical terms on computer vision 2. Understand 2D image processing 3. Understand image pattern recognition 4. Understand 3D image processing	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	The achievement of the above goals is evaluated through the short tests (30%) and the term-end examination (70%).		
Assignment Instructions (授業外学習(予習・復習)の指示)	The preparation for the classes, at least 4 hours per week, is required.		
Keywords(キーワード)	2D image processing, image pattern recognition, stereo vision, inverse rendering		
Required Textbooks(教科書)	奥富 正敏 編「ディジタル画像処理[改訂第二版]」(CG-ARTS協会)		
References/Recommended Reading(参考書)	石井 健一郎 他著「わかりやすいパターン認識」(オーム社) 徐 剛 他著「3次元ビジョン」(共立出版) 八木 康史 他著「コンピュータビジョン最先端ガイド1-6」(アドコム・メディア)		
Notes(備考)			
Email(電子メールアドレス)	okabe@ai.kyutech.ac.jp		

Course Name(科目名)	Advanced Course in Computer Vision II		
Instructor Name(担当教員名)	Takahiro Okabe		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The aim of computer vision is to realize human visual system through computation. The methodologies in computer vision are classified into geometric approaches and photometric approaches; the former studies the relationship between the coordinates of 2D images and 3D scenes, and the latter studies the relationship between the 2D images and the scenes' description such as shape, reflectance, and illumination. In this advanced course, we study the photometric approaches in computer vision from their basic theories, applications, and recent research trends with programming exercises.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This advanced course is related to the following ones: Advanced Course in Computer Vision I, Advanced Topics in Image Processing, Advanced Course of Digital Image Processing, Video Image Processing, Advanced Course in Pattern Understanding, Advanced Computer Graphics I, and Advanced Computer Graphics II.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Measurement of light and color	
	2.	Representation of light and color	
	3.	Exercise 1	
	4.	Image formation process	
	5.	Image noise	
	6.	Exercise 2	
	7.	Measurement and modeling of reflect	
	8.	Measurement and modeling of scatte	
	9.	Measurement and estimation of illum	
	10.	Shape recovery: shape from shading	
	11.	Shape recovery: photometric stereo	
	12.	Exercise 3	
	13.	Computational photography: light fiel	
	14.	Computational photography: coded a	
	15.	Computational photography: active ill	
General Course Policies(授業の進め方)	Some reports are assigned. The slides for the classes are distributed via Moodle.		
Course Objectives (授業の達成目標) / Introduction to Couse Objectives (授業の達成目標の解説)	The goals of this advanced course are as follows.		
Course Objectives (授業の達成目標) / Couse objectives (具体的な授業の達成目標)	1. Understand the basic photometric approaches in computer vision. 2. Understand the recent research trends in computer vision 3. Implement the basic algorithms in computer vision		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	The achievement of the above goals is evaluated through the reports (100%).		
Assignment Instructions (授業外学習(予習・復習)の指示)	The preparation for the classes, at least 4 hours per week, is required.		
Keywords(キーワード)	Image formation process, image noise, reflection, scattering, illumination estimation, shape recovery, computational photography, image quality improvement		
Required Textbooks(教科書)	The textbooks in "References/Recommended Reading" are recommended if necessary.		
References/Recommended Reading(参考書)	コンピュータビジョン最先端ガイド4　八木康史, 斎藤英雄 編(アドコム・メディア) コンピュータビジョン最先端ガイド5　八木康史, 斉藤英雄 編(アドコム・メディア) ディジタル画像処理　奥富正敏 他編(CG-ARTS協会)		
Notes(備考)			
Email(電子メールアドレス)	okabe@ai.kyutech.ac.jp		

Course Name(科目名)	Advanced Computer Graphics I		
Instructor Name(担当教員名)	Tsukasa Noma		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course introduces fundamental concepts and basic techniques of computer graphics. Graphics API programming as well as the theoretical foundations of graphics are discussed.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The prerequisite of the couse is mastery of elementary mathematical analysis, linear algebra, and programming in C/C++.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	History and raster graphics	
	2.	2D graphics with OpenGL	
	3.	2D and 3D geometric transformations	
	4.	Projection	
	5.	Viewing pipeline	
	6.	3D graphics with OpenGL	
	7.	Input and interaction	
	8.	Hidden surface removal	
	9.	Shading	
	10.	Shading in OpenGL	
	11.	Shadowing and mapping	
	12.	Global illumination and modeling	
	13.	Curves and surfaces	
	14.	Recent trends in graphics	
	15.	Final exam	
	16.	Final exam explanation	

General Course Policies(授業の進め方)		In addition to lecture, paper exercises are given in the class, and programming in OpenGL is assigned for outside-class learning.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal of this couse is the understanding of the basics of computer graphics. Students are expected to:
	Couse objectives (具体的な授業の達成目標)	1. Understand fundamental concepts of computer graphics 2. Understand mathematical foundations of computer grahpics and master their caluculation (by hand) 3. Develop graphics programs with OpenGL and understand the relationship between graphics concepts and API specs
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		In the above objectives, all the items are evaluated with programming assignments (100%). As per request from students, the first and second items may be evaluated with final exam (50%), and the third item with programming assignments (50%).
Assignment Instructions (授業外学習(予習・復習)の指示)		Paper exercises in the class are helpful to review. Programming assignments are worth for taking sufficient time outside of class. The course will require 4 hours of preparation work per week.
Keywords(キーワード)		computer graphics, geometric transformation, projection, rendering, hidden surface removal, shading, modeling, curves and surfaces, OpenGL
Required Textbooks(教科書)		* Compute Graphics Editorial Committee(ed): Computer Graphics (new revised ed), CG-Arts Society (in Japanese) Additional materials are distributed as required.
References/Recommended Reading(参考書)		* Hughes, et al: Computer Graphics, Addison-Wesley * Rogers: Procedural Elements for Computer Graphics, McGraw-Hill * Shreiner, et al: OpenGL Programming Guide, Addison-Wesley
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Natural Language Processing Technology		
Instructor Name(担当教員名)	Kazutaka Shimada		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Natural language processing is one of the most important tasks in artificial intelligence. In this class, I lecture traditional approaches and data-driven approaches in NLP.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture relates to the Adovanced Natural Language Processing.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	About Natural Language Processing	Foundation of NLP
	2.	Corpus	Data for NLP
	3.	Language model	n-gram
	4.	Sequence analysis	Morphological analysis
	5.	Syntactic analysis (1)	CYK and Chart
	6.	Syntactic analysis (2)	Probabilistic model
	7.	Semantic analysis (1)	Word meanings
	8.	Semantic analysis (2)	Case analysis
	9.	Comprehension check	Quiz
	10.	Context analysis	Anaphora resolution
	11.	Information retrieval	Tfidf and Vector space model
	12.	Machine learning (1)	Perceptron and SVM
	13.	Machine learning (2)	k-means
	14.	Text classification	NLP with machine learning
	15.	Summary	Summary of NLP

General Course Policies(授業の進め方)		Lecture based on textbook
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The objective of this lecture is to understand the basic elements of natural language processing.
	Couse objectives (具体的な授業の達成目標)	1. Understanding about language models 2. Understanding about syntactic and semantic analysis methods 3. Understanding about data-driven approaches
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Exams and report
Assignment Instructions (授業外学習(予習・復習)の指示)		Preparations for the class: 4 hours per week
Keywords(キーワード)		Natural language processing, corpus, text mining
Required Textbooks(教科書)		Manabu Okumura, Introduction to natural language processing, CORONA publishing CO. , LTD.
References/Recommended Reading(参考書)		Hiroya Takamura, Machine learning for natural language processing, CORONA publishing CO. , LTD.
Notes(備考)		
Email(電子メールアドレス)		shimada@pluto.ai.kyutech.ac.jp

Course Name(科目名)	Pattern Recognition		
Instructor Name(担当教員名)	Shuichi Enokida		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	A large number of products using a pattern recognition technology, such as the recognition of personal face and gestures, brought about great changes in our lives. To understand, implement and evaluate these applications based on the artificial intelligence, this class focuses on the basic principle of the pattern recognition, especially on "Bayes' classifier", "Linear discriminant function", "Ensemble learning".		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)			

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction	
2.	Classifier performance evaluation	Generalization capability
3.	Bayes' classifier (1)	Maximum a posteriori estimation method
4.	Bayes' classifier (2)	Parametric methods: Maximum likelihood Estimation(1)
5.	Bayes' classifier (3)	Parametric methods : Maximum likelihood Estimation (2)
6.	Bayes' classifier (4)	Nonparametric methods : k-Nearest Neighbor
7.	Bayes' classifier (5)	Nonparametric methods : Kernel density estimation
8.	Linear discriminant function (1)	Fisher's linear discriminant
9.	Linear discriminant function (2)	Evaluation :Kullback-Leibler divergence, Akaike's Information Criteric
10.	Linear discriminant function (3)	Perceptron Learning Algorithm
11.	Linear discriminant function (4)	Support Vector Machine
12.	Ensemble learning (1)	Bagging, Boosting
13.	Ensemble learning (2)	Randomforests, or the like
14.	Reducing dimension	Eigenvalue, eigen vector
15.	Conclusion	

General Course Policies(授業の進め方)	This class will be given according to the above "Class Topics" schedule.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. Understanding the flow from the construction of a classifier to its evaluation. 2. Understanding methods for determining discrimination boundaries. 3. Understanding ensemble learning algorithms. 4. Understanding methods to reduce dimension.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Examination (60%) and reports (40%).	
Assignment Instructions (授業外学習(予習・復習)の指示)	Study in advance at least 4 hours in a week.	
Keywords(キーワード)	Bayes' classifier, linear discriminant function, ensemble learning.	
Required Textbooks(教科書)	None (only handouts).	
References/Recommended Reading(参考書)	"Pattern Classification", written by Richard O. Duda, Peter E. Hart, David G. Stork.	
Notes(備考)		
Email(電子メールアドレス)	enokida.shuichi453@mail.kyutech.jp	

Course Name(科目名)	Advanced Corporate Information System		
Instructor Name(担当教員名)	Koji Murata, Masaki Yamamoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The goal of this course is the understanding of "the role of information systems" and "approaches to designing information systems" in business companies. Today's information systems should support business activities and enhance enterprise value. The course consists of two halves: The first half discusses changes in business environment, required human resources for the changes, and analyzes entire corporate business issues by collaborative team activities. The second half outlines the roles of business departments and the need for business transformation, followed by business assessment workshop.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is designed to lead students to understand the role and design of information systems in the real world. Students are encouraged to take other courses in ICT and cloud computing.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Changes in business environment and recent success factors in Japanese business	
	2.	Required human resources for the changes in business environment	
	3.	Corporate basic activities, philosophy, vision, and strategy	
	4.	Introduction to corporate analysis methodology – marketing analysis, financial statements analysis, issue analysis	
	5.	Groupwork and presentation of issue list of a real company	
	6.	Roles of departments in a company	
	7.	Approach to business transformation	
	8.	Business assessment for the adoption of ICT	
	9.	Business assessment workshop for the adoption of ICT	

General Course Policies(授業の進め方)		The course includes lecture, discussion, group work, and presentation.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students are expected to:
	Couse objectives (具体的な授業の達成目標)	1. Master the approaches to corporate analysis and corporate strategy planning, as well as the principles of thinking. 2. Develop skills in analyzing real companies, listing their issues, and presenting the solution proposals from a wide perspective 3. Understand approaches to business transformation and master the principles of business assessment for the adoption of ICT
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		In the above objectives, the first item is evaluated with (a) and (b) below, the second item is with (c), and the third is with (a) and (d). (a) Participation in discussion and groupwork (20%) (b) Mid-term report of realization, awareness of personal issues ("KI-ZU-KI") (10%) (c) Mid-term groupwork and presentation of issues list of a company (30%) (d) Presentation at the final business assessment workshop (40%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Following directions in the class, students should prepare reports and presentations in time. The course will require 4 hours of preparation work per week.
Keywords(キーワード)		changes in business, principles of thinking, mind change, principles of corporate activities, corporate philosophy, corporate vision, corporate strategy, information systems planning, business process, logical thinking, business assessment, financial statements analysis
Required Textbooks(教科書)		Lecture slides are distributed.
References/Recommended Reading(参考書)		Reference materials are recommended as required.
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Programming Languages and Systems II		
Instructor Name(担当教員名)	Kento Emoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course is an introduction to the theory, design, and implementation of functional programming languages. Topics covered in this course include: lamnda calculus, evaluation of functional programs, type systems, type inference, optimization, garbage collection, parallel computation, and formal verification.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Course "Programming Languages and Systems I" is recommended.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	A variety of programming languages, a flavor of functional programmi
	2.	Functions	Functions as programs, higher-order functions
	3.	List	List data structure in functional programming, list-manipulating funct
	4.	Algebraic Data Types	User-defined data structures; list, binary tree and so on.
	5.	Type Classes	Ad-hoc polymorphism in functional programming
	6.	Monad	Effects in purely functional programming
	7.	Exercise	Writing your own application with functional languages; functional bal
	8.	Type Check	Type system, type checker
	9.	Type Inference	Type inference, Hindley-Milner type system
	10.	Normalization	CPS(continutation passing style), A-normal form, K-normal form
	11.	Optimization and Closure Conversion	Constant folding/propagation, dead-code elimination, alpha-conversi
	12.	Register Allocation and Code Genera	Register allocation, abstract machine, assembly language
	13.	Laziness	Template Instantiation, G-machine, Circular programming
	14.	Lambda Calculus	Lambda calculus, lambda cube, turing machine, recursive function
	15.	Summary	Summary of the course, advanced topics

General Course Policies(授業の進め方)		15 classes, each with small exercises. Bringing your own PCs is recommended; to run programs in some hands-on exercises.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	At the end of the course, participants are expected to explain how functional languages work. The goals of this course are to
	Course objectives (具体的な授業の達成目標)	1. Be able to write functional programs by using higher order functions, algebraic data types, type classes 2. Be able to explain stages of a functional language compiler and how a functional program is transformed 3. Understand the theoretical background of functional programming languages
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Final report (80%) + exercises (20%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Students are expected to spend four hours a week for preparation.
Keywords(キーワード)		Programming languages, Functional programming, Haskell, Type systems, Compiler, Formal verification
Required Textbooks(教科書)		None. Some materials will be supplied by the lecturere.
References/Recommended Reading(参考書)		* Richard Bird: "Introduction To Functional Programming", 2nd Edition, Prentice Hall. * Benjamin C. Pierce: "Types and Programming Languages", MIT Press. * Yves Bertot and Pierre Casteran: Interactive "Theorem Proving and Program Development: Coq' Art: The Calculus of Inductive Constructions", Springer.
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Programming Languages and Systems I		
Instructor Name(担当教員名)	Masahiro Yasugi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The course covers programming language topics such as syntax and semantics, the object-oriented paradigm, and type systems. In addition, the course covers topics for programming language systems such as garbage collection techniques, structures of language systems and compilers, and implementation techniques for parallel language systems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Students are expected to have some prior knowledge of the C programming language, compilers, parallel computers. In addition, some prior knowledge of the Java programming language is helpful.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Programming languages and virtual m	
	2.	The object-oriented paradigm and ty	
	3.	Garbage collection and weak referen	
	4.	Garbage collection techniques	
	5.	Structures of language systems and	
	6.	Implementation techniques for paralle	
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)	Two or more lectures on each topic are given. Students are required to submit reports on some subjects and take an examination.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. To acquire the ability to understand and think the design of language specifications such as the object- 2. To master the structure and implementation of programming language systems such as garbage 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	The evaluation is based on submitted reports (50%) and an examination (50%).	
Assignment Instructions (授業外学習(予習・復習)の指示)	Students are required to read course materials before every class. Students are required to write and submit reports on some subjects. Students are required to reserve four hours a week for preparing classes.	
Keywords(キーワード)	programming languages, the Java language, type systems, language systems, garbage collection, parallel language	
Required Textbooks(教科書)	Course materials will be indicated during lectures.	
References/Recommended Reading(参考書)	N/A	
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Natural Language Processing		
Instructor Name(担当教員名)	Kazutaka Shimada		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	A huge number of on-line documents are easily accessible on the Web. Therefore, natural language processing (NLP) has become important. In this class, I introduce machine learning techniques for NLP and lecture about the applications.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture relates to the Natural Language Processing Technology.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Foundation of NLP (1)	morphological analysis and syntactic analysis
2.	Foundation of NLP (2)	semantic analysis and context analysis
3.	Foundation of statistical NLP	n-gram language model
4.	Machine Learning for NLP (1)	Naïve Bayes
5.	Machine Learning for NLP (2)	Support Vector Machines
6.	Machine Learning for NLP (3)	Deep learning
7.	Application (1)	Text mining
8.	Application (2)	Information extraction
9.	Application (3)	Text classification
10.	Application (4)	Sentiment analysis
11.	Application (5)	Text summarization
12.	Application (6)	Dialogue summarization
13.	Application (7)	Question-Answering
14.	Application (8)	Textual entailment
15.	Application (9)	Multimodal interpretation

General Course Policies(授業の進め方)		Lecture based on handouts and presentation by students
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The objective of this lecture is to understand the basic elements of natural language processing.
	Couse objectives (具体的な授業の達成目標)	1. Understanding how to handle text in computers 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Report and presentation by each student
Assignment Instructions (授業外学習(予習・復習)の指示)		Preparations for the class: 4 hours per week
Keywords(キーワード)		Natural language processing, corpus, text mining
Required Textbooks(教科書)		Handouts
References/Recommended Reading(参考書)		Hiroya Takamura, Machine learning for natural language processing, CORONA publishing CO. , LTD.
Notes(備考)		
Email(電子メールアドレス)		shimada@pluto.ai.kyutech.ac.jp

Course Name(科目名)	Compressed Data Processing		
Instructor Name(担当教員名)	Tomohiro I		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Data compression aims at removing the redundancy of data. Although data compression has been developed to store and/or transmit data efficiently, it tends to prevent us from using the data as we usually have to pay the cost of expanding the compressed data. Recently this problem becomes much more apparent since large scale data are ubiquitous. To solve this problem, lots of work have been dedicated to ″compressed data processing″, which process compressed data without explicitly expanding them or utilize compression for increasing the efficiency. In this lecture we will learn the theory of compressed data processing.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The aim of this course is to learn the theory of compressed data processing. Students who take the course ought to have basic knowledge on how to evaluate algorithms and data structures.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction to Data Compression	
	2.	Grammar Compression	
	3.	Data Processing on Grammar Compr	
	4.	Locally Consistent Parsing	
	5.	Applications of Locally Consistent Pa	
	6.	Succinct Data Structures	
	7.	Applications of Succinct Data Struct	
	8.	Burrows-Wheeler Transform (BWT)	
	9.	Data Processing on BWT	
	10.	Lempel-Ziv (LZ) Compression	
	11.	Data Processing on LZ-compressed	
	12.	Recompression	
	13.	Compression Measures	
	14.	Data Compression of Various Data T	
	15.	Conclusions	
General Course Policies(授業の進め方)	Lectures are given with slides that will be available online. When needed, there will be some exercises to help understanding. Some short reports will be also assigned.		
Course Objectives (授業の達成目標) / Introduction to Couse Objectives (授業の達成目標の解説)	This course aims at learning the theory of compressed data processing methods, which have been developed recently. More concretely, the objectives are		
Course Objectives (授業の達成目標) / Couse objectives (具体的な授業の達成目標)	1. to recognize redundancies in data and to understand that data compression plays an important role in 2. to understand how to evaluate the data compression methods, 3. to learn how to choose an appropriate compression method in accordance with requirements.		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	The final report (70%) and short reports (30%).		
Assignment Instructions (授業外学習(予習・復習)の指示)	Students ought to spend at least 4 hours a week to keep up with the class for looking over slides before lectures or consulting slides and references for reports.		
Keywords(キーワード)	Data Compression, Data Processing, Pattern Matching, Approximate Matching, Indexing, Algorithms and Data Structures		
Required Textbooks(教科書)	Slides published online		
References/Recommended Reading(参考書)	定兼 邦彦, 簡潔データ構造, 共立出版 岡野原 大輔, 高速文字列解析の世界――データ圧縮・全文検索・テキストマイニング, 岩波書店 Gonzalo Navarro, Compact Data Structures: A Practical Approach, Cambridge University Press		
Notes(備考)			
Email(電子メールアドレス)	tomohiro@ai.kyutech.ac.jp		

Course Name(科目名)	Introduction to Robust Control Theory		
Instructor Name(担当教員名)	Noboru Sebe		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Robust control concerns the analysis and design of control systems that take into account the presence of uncertainties, i.e., the unmodelled dynamics and/or unknown parameters. This course focuses on robust control methodologies for linear systems. Topics include: Signal and system norms and performance measures, robust stability and performance, uncertainty modeling, structured uncertainty analysis and synthesis, and gain-scheduled control. The purpose of thie course is to provide the students with the principles and tools of robust control theory: robustness, uncertainty, H-infinity norm, Linear matrix inequatlity, gain-scheduled control, descriptor systems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The students should have enough knowledge about the control theory based on the state space representation. This class is a part of robust control modules.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction to robust control	
	2.	Review of linear systems	
	3.	Inportance of robust control	
	4.	Descripton of uncertainties	
	5.	H-infinity norm of systems	
	6.	H-infinity control	
	7.	Generalized plant	
	8.	Linear matrix inequality	
	9.	Structured singular value	
	10.	Robust performance	
	11.	Gain-scheduled control	
	12.	Parametric uncertaines	
	13.	Descriptor representation	
	14.	Analysis of descriptor systems	
	15.	Controller design of descriptor syste	
General Course Policies(授業の進め方)	Lecture		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This class introduces concepts in optimal and robust control theory.	
	Couse objectives (具体的な授業の達成目標)	1. The students should be able to characterize robustness and optimality of H-infinity control. 2. The students should be able to emply linear matrix inequality methos to analyze nad synthesize the 3. The students should be able to synthesize gain-scheduled control systems.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	100% - Homework/Assignments		
Assignment Instructions (授業外学習(予習・復習)の指示)	The students are expected to prepare for this class more than 4 hours a week.		
Keywords(キーワード)	Robust control, Uncertainty, H-infinity norm, Linear matrix inequality, Descriptor systems, Gain-scheduled control		
Required Textbooks(教科書)	None		
References/Recommended Reading(参考書)	K. Zhou, J. C. Doyle, and K. Glover, Robust and optimal control, Rentice Hall. G.-R. Duan, LMIs in Control Systems: Analysis, Design and Applications, CRC Press.		
Notes(備考)			
Email(電子メールアドレス)			

Course Name(科目名)		Advanced Multimedia Engineering		
Instructor Name(担当教員名)		Tsukasa Noma		
Course intended for(対象学年)		1st or 2nd year student		
Credit Category(単位区分)		Elective course	Credits(単位数)	2
Course Description(授業の概要)		This course introduces representations and processing of multimedia data, e.g. images and sounds, with an emphasis on graphics, and then discusses their state-of-the-art techniques with students' presentation on latest researches in multimedia.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)		The prerequisite of the course is undergraduate-level knowledge of computer science. No expert knowledge of media processing is required.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)	
		1. Multimedia and its history 2. Multimedia data processing (4 classes) 3. Computer animation 4. Virtual reality 5. Virtual human agent 6. Multimedia data translation and integration 7. Evaluation of multimedia systems 8. Paper presentation and critique (5 classes)		
General Course Policies(授業の進め方)		The course consists of two parts: The first part sketches principles of multimedia data processing. In the second part, students are responsible for presenting a recently published paper on multimedia and leading its discussion.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal of this course is the understanding of basic representations and processing of multimedia. Students are expected to:		
	Couse objectives (具体的な授業の達成目標)	1. Understand the features and basic processing techniques on multimedia 2. Master how to apply basic processing techniques to various types of multimedia data 3. Understand the outline of multimedia techniques in state-of-the-art applications		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		In the above objectives, all the items are evaluated with participation and attitude (40%) and paper presentation and discussion (60%).		
Assignment Instructions (授業外学習(予習・復習)の指示)		Following directions in the class, students should prepare paper presentation. It needs (and is worth) taking sufficient time. The course will require 4 hours of prepraration work per week.		
Keywords(キーワード)		multimedia, computer graphics, animation, virtual reality, virtual human agent		
Required Textbooks(教科書)		Lecture slides and additional materials are distributed.		
References/Recommended Reading(参考書)		Reference materials are recommended as required.		
Notes(備考)				
Email(電子メールアドレス)				

Course Name(科目名)	Digital Video Processing		
Instructor Name(担当教員名)	Shuichi Enokida		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Many cameras have been implemented into our living environment for monitoring and other purposes. In the near future, most of the processing to deal with those tasks will be changed from the processing to need observation by the operator to automated one. To understand, implement and evaluate these image processing applications, this class focuses on the basic principle of the video / image processing, especially on "Motion Detection / Estimation", "Object Tracking" and "Structure from Motion".		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This class is one of the classes in "Image Processing Module".		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	
	2.	Motion Detection	Background Subtraction, Temporal Difference, (+ RANSAC)
	3.	Motion Estimation (1)	Block Matching, Gradient-based method (1)
	4.	Motion Estimation (2)	Gradient-based method (2)
	5.	Programming exercises (A)	
	6.	Object Tracking (1)	Particle Filter Algorithm
	7.	Object Tracking (2)	Mean-Shift Algorithm
	8.	Programming exercises (B)	
	9.	Structure from Motion (1)	Projection, Camera Models
	10.	Structure from Motion (2)	Stereo Vision (Epipolar geometry)
	11.	Structure from Motion (3)	Camera Pose Estimation from Calibrated Images
	12.	Structure from Motion (4)	Structure from Motion
	13.	Presentation (1)	(5 minutes per person)
	14.	Presentation (2)	(5 minutes per person)
	15.	Conclusion	

General Course Policies(授業の進め方)	This class will be given according to the above "Class Topics" schedule. At 13th and 14th lectures, students will be required to give a short presentation about a paper published at an international conference.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. Understanding the flow from the construction of a classifier to its evaluation. 2. Understanding methods for determining discrimination boundaries. 3. Acquiring skills to implement video image processing algorithms.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Reports (60%), Presentation (40%).	
Assignment Instructions (授業外学習(予習・復習)の指示)	Study in advance at least 4 hours in a week.	
Keywords(キーワード)	Motion Detection and Estimation, Tracking, Structure from Motion	
Required Textbooks(教科書)	None	
References/Recommended Reading(参考書)	"Handbook of Image and Video Processing 2nd Edition", written by Alan Bovik. "Multiple View Geometry in Computer Vision 2nd Edition", written by Richard Hartley and Andrew Zisserman.	
Notes(備考)		
Email(電子メールアドレス)	enokida.shuichi453@mail.kyutech.jp	

Course Name(科目名)	User Modeling		
Instructor Name(担当教員名)	Hidenobu KUNICHIKA		
Course intended for(対象学年)	1st , 2nd or 3rd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course provides a methodology for estimating users' thought by a computer. Specifically, methods of estimating and storing the thought process and the knowledge of a user by using computer is provided. Moreover, as an example of using the result of user modeling, a method in which a computer constructs a user model and adjusts the behavior is also described.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course relates to both Basis of Artificial Intelligence and AI Programming.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	User modeling and knowledge engine	
	2.	Methods of user modeling	Procedural knowledge and declarative knowledge, Formalization of us
	3.	Applications of user modeling	Intelligent Tutoring Systems
	4.		
	5.		
	6.		
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lecture, programming and presentation
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to achieve the goals "Development of a new mechanism of intelligent information processing in which humans and computers cooperate" for the Division of Artificial Intelligence and "Utilization of the latest information technology and business-oriented research and development based on real-world needs" for the Division of Creative Informatics, the following items are the objectives of this course. These aim to acquire common goal (B) "Basic academic ability required in information science and engineering and various fields" for Graduate School of Computer Science and Systems Engineering.
	Couse objectives (具体的な授業の達成目標)	1. Understanding methods of user modeling 2. Understanding methods of using the results of user modeling 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The degree of understanding , presentations, the participation in discussion will be assessed.
Assignment Instructions (授業外学習(予習・復習)の指示)		Examine the keywords mentioned in the course before and after by using related books or the Web. Note that four hours a week for preparations are necessary.
Keywords(キーワード)		User modeling, Knowledge representation, Thought process, Dialogue systems
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		kunitika@ai.kyutech.ac.jp

Course Name(科目名)	Knowledge and Thinking Process Modeling		
Instructor Name(担当教員名)	Hidenobu KUNICHIKA		
Course intended for(対象学年)	1st , 2nd or 3rd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course provides a methodology for estimating users' thought by a computer. Specifically, methods of estimating and storing the thought process and the knowledge of a user by using computer is provided. Moreover, as an example of using the result of user modeling, a method in which a computer constructs a user model and adjusts the behavior is also described.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course relates to both Basis of Artificial Intelligence and AI Programming.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	User modeling and knowledge engine	
2.	Methods of user modeling	Procedural knowledge and declarative knowledge, Formalization of us
3.	Applications of user modeling	Intelligent Tutoring Systems
4.		
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General Course Policies(授業の進め方)		Lecture, programming and presentation
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to achieve the goals "Development of a new mechanism of intelligent information processing in which humans and computers cooperate" for the Division of Artificial Intelligence and "Utilization of the latest information technology and business-oriented research and development based on real-world needs" for the Division of Creative Informatics, the following items are the objectives of this course. These aim to acquire common goal (B) "Basic academic ability required in information science and engineering and various fields" for Graduate School of Computer Science and Systems Engineering.
	Couse objectives (具体的な授業の達成目標)	1. Understanding methods of user modeling 2. Understanding methods of using the results of user modeling 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The degree of understanding , presentations, the participation in discussion will be assessed.
Assignment Instructions (授業外学習(予習・復習)の指示)		Examine the keywords mentioned in the course before and after by using related books or the Web. Note that four hours a week for preparations are necessary.
Keywords(キーワード)		User modeling, Knowledge representation, Thought process, Dialogue systems
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		kunitika@ai.kyutech.ac.jp

Course Name(科目名)	Advanced Multimedia Representation			
Instructor Name(担当教員名)	Tsukasa Noma			
Course intended for(対象学年)	1st or 2nd year student			
Credit Category(単位区分)	Elective course		Credits(単位数)	2
Course Description(授業の概要)	This course introduces representations and processing of multimedia data, e.g. images and sounds, with an emphasis on graphics, and then discusses their state-of-the-art techniques with students' presentation on latest researches in multimedia.			
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The prerequisite of the course is undergraduate-level knowledge of computer science. No expert knowledge of media processing is required.			
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)	
	1.	Multimedia and its history		
	2.	Multimedia data processing (4 classes)		
	3.	Computer animation		
	4.	Virtual reality		
	5.	Virtual human agent		
	6.	Multimedia data translation and integration		
	7.	Evaluation of multimedia systems		
	8.	Paper presentation and critique (5 classes)		
General Course Policies(授業の進め方)	The course consists of two parts: The first part sketches principles of multimedia data processing. In the second part, students are responsible for presenting a recently published paper on multimedia and leading its discussion.			
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal of this course is the understanding of basic representations and processing of multimedia. Students are expected to:		
	Couse objectives (具体的な授業の達成目標)	1. Understand the features and basic processing techniques on multimedia		
		2. Master how to apply basic processing techniques to various types of multimedia data		
		3. Understand the outline of multimedia techniques in state-of-the-art applications		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	In the above objectives, all the items are evaluated with participation and attitude (40%) and paper presentation and discussion (60%).			
Assignment Instructions (授業外学習(予習・復習)の指示)	Following directions in the class, students should prepare paper presentation. It needs (and is worth) taking sufficient time. The course will require 4 hours of prepraration work per week.			
Keywords(キーワード)	multimedia, computer graphics, animation, virtual reality, virtual human agent			
Required Textbooks(教科書)	Lecture slides and additional materials are distributed.			
References/Recommended Reading(参考書)	Reference materials are recommended as required.			
Notes(備考)				
Email(電子メールアドレス)				

Course Name(科目名)	Advanced Computer Systems Ⅱ		
Instructor Name(担当教員名)	Akihiro FUJIWARA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The course consists of a series of sessions on the followings. 1. Theoretical evaluation of the algorithms. 2. An overview, basic techniques and evaluations of algorithms for parallel and distributed processing. 3. Recent topics for parallel and distributed processing.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is designed to provide an introduction on the theory of parallel and distributed processing. Basic knowledge for the algorithm is needed.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	An introduction on algorithms and co	
	2.	An overview of parallel processing	
	3.	Complexity of a parallel algorithm	
	4.	Basic techniques for parallel algorith	
	5.	Basic techniques for parallel algorith	
	6.	Recent topics for parallel and distrib	
	7.	Recent topics for parallel and distrib	
	8.	Recent topics for parallel and distrib	
	9.	Middle exercise	
	10.	An overview of distributed processin	
	11.	Basic distributed algorithms 1 (leade	
	12.	Basic distributed algorithms 2 (logica	
	13.	Recent topics for parallel and distrib	
	14.	Final exercise	
	15.	Exam	

General Course Policies(授業の進め方)		Materials for the lecture is distributed electrically.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The basic objectives of the lecture are understanding and acquiring knowledges for algorithms in parallel and distributed processing.
	Couse objectives (具体的な授業の達成目標)	1. Understanding for models and basic algorithms in parallel processing 2. Understanding for models and basic algorithms in distributed processing 3. Acquiring deep knowledges for recent topics in parallel and distributed processing
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Score is evaluated according to the final exam (100%).
Assignment Instructions (授業外学習(予習・復習)の指示)		Materials is distributed using Moodle. Preparation for 4 hours per week is needed.
Keywords(キーワード)		parallel and distributed processing, algorithms
Required Textbooks(教科書)		none
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		fujiwara@cse.kyutech.ac.jp

Course Name(科目名)	Analog Information Processing Circuits		
Instructor Name(担当教員名)	Naoki Konishi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Learn about sensing technology for receiving information on the state of the natural world, such as light, sound, heat, and movement, to a computer or the like. In addition, based on information processed by a computer, etc., learn the technology of controlling the state of nature, such as moving an object or changing its temperature.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is in the field of computational complexity and basic theory of parallel distributed processing.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Natural phenomena and sensing	
	2.	Sensor type	
	3.	Actuator type	
	4.	Various interfaces	
	5.	Control circuit	
	6.	Information processing and control	
	7.	Individual research report (7 times)	
	8.	Freedom issues	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		In the first half, lectures are given, and in the second half, each student decides on a theme and gives a presentation.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	To deepen the basic knowledge of electronics and information engineering, information and communication knowledge and technology, and to acquire expertise in application
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluation based on presentation presentation contents and report contents
Assignment Instructions (授業外学習(予習・復習)の指示)		As the time of prep, ensuring 2 hours a week
Keywords(キーワード)		Electronic circuits, interfaces, sensors, actuators, signal and information processing
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Vacuum technology on semiconductor		
Instructor Name(担当教員名)	SHINKAI Satoko		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This class will be given on the fabrication of next-generation semiconductor devices that apply new materials and new process technologies to device manufacturing process. In particular, it will explain in detail the handling of vacuum tools that is indispensable for semiconductor manufacturing.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The vacuum technology will be explain in the field of semiconductor manufacturing technology.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	characteristics of gas	characteristics of gas
2.	chsracteristics of gas	characteristics of gas
3.	chsracteristics of gas	vacuum technology
4.	chsracteristics of gas	Maxwell-Boltzmann
5.	chsracteristics of gas	Adsorption equilibrium
6.	chsracteristics of gas	Adsorption equilibrium
7.	vacuum tools	vacuum pump
8.	vacuum tools	vacuum pump
9.	vacuum tools	conductance
10.	vacuum tools	vacuum materials
11.	vacuum tools	leak detection
12.	vacuum tools	vacuum gauge
13.	vacuum tools	vacuum gauge
14.	vacuum tools	How to measure vacuum
15.		summary

General Course Policies(授業の進め方)		PPT will be used. You have to downroad PPT.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This class aims to understand the principles of vacuum technology. You have to work on your studies 4 hours a week.
	Couse objectives (具体的な授業の達成目標)	1. Understand the relationship between vacuum and gas. 2. Understand the relationship between vacuum pumps and gauges 3. Understand the desigh of vacuum tools.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)"		Evaluate in the report. (100%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Understand the content of the vacuum technology well and review it thoroughly.
Keywords(キーワード)		vacuum, semiconductor, process, manufacturing, gas
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		shinkai@cms.kyutech.ac.jp

Course Name(科目名)	Advanced course on Biodevices		
Instructor Name(担当教員名)	Kenji Sakamoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this lecture, the biodevices used for the biotechnology and medical diagnosis will be lectured. In addition, the basic technology required for biodevices will be explained.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture is positioned as the application of semiconductor microfabrication technology and sensor technology to biodevices.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction	
2.	Behavior of Biodevice 1	
3.	Behavior of Biodevice 2	
4.	Microfabrication 1	
5.	Microfabrication 2	
6.	Microfluidics 1	
7.	Microfluidics 2	
8.	Control element of microfluidics	
9.	Material	
10.	Surface technology	
11.	Sensor technology 1	
12.	Sensor technology 2	
13.	Introduction of Biodevice 1	
14.	Introduction of Biodevice 2	
15.	Conclusion	

General Course Policies(授業の進め方)		Lecture about the basic technology required for biodevices, and reports (doing in lecture time)
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal of this lecture is to understand the biodevice for biotechnology and medical diagnosis.
	Couse objectives (具体的な授業の達成目標)	1. Understanding the basic technology required for biodevices 2. Understanding sensor, microfluidics, microfabrication for biodevices 3. Finding knowledge for development
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Simple reports (60% of evaluation), and Period end report (40% of evaluation)
Assignment Instructions (授業外学習(予習・復習)の指示)		Prepare for 4 hours
Keywords(キーワード)		Biodevice, Medical device, Biosensor, Microfluidics, Microfabricaltion
Required Textbooks(教科書)		Nothing
References/Recommended Reading(参考書)		Nothing
Notes(備考)		Nothing
Email(電子メールアドレス)		sakamoto@cms.kyutech.ac.jp

Course Name(科目名)	Advanced Course on Microelectronic Systems		
Instructor Name(担当教員名)	Akiyoshi BABA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This class will provide education on both a semiconductor microfabrication technology and a fabrication of three-dimensional intelligent microsystems that fuse micromachines and microelectronics.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The purpose of this lecture is to introduce specialized education to train engineers related to intelligent sensors that integrate micromachines and microelectronics. The main purpose of this lecture is to deepen the understanding of the expertise in micromachining technology required for these engineers. It is desirable, but not required, to take the following undergraduate courses or have equivalent knowledge. Electromagnetics, material mechanics, electric circuits, electronic circuits, semiconductor engineering, LSI circuits, integrated circuit design.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Position of micromachining in the en	Lecture on positioning of microfabrication from the perspective of m
	2.	Processing technology (classification	Lectures on size effects of physical quantities and the relationship b
	3.	LSI processing technology (planar te	Lecture on planar technology used in LSI fabrication, a representativ
	4.	Photolithography 1	Lecture on photolithography overview
	5.	Photolithography 2	Lecture on photolithography techniques used in planar technology
	6.	Etching 1	Lecture on types and characteristics of etching
	7.	Etching 2	Lecture on etching techniques in specific situations
	8.	Film growth / deposition 1	Lecture on types and characteristics of film growth and deposition
	9.	Film growth / deposition 2	Lecture on film growth and deposition techniques in specific situatio
	10.	Process integration 1	Lecture on integration technology, which is a combination of element
	11.	Process integration 2	Lecture on specific integration technologies
	12.	Differences between LSI processing	Lecture on differences between MEMS technology and LSI processi
	13.	Features of MEMS technology	Lecture on features of MEMS technology
	14.	Micro sensors and micro systems	Lecture on fusion device technology combining MEMS technology an
	15.	Explanation of report issues	Explain the report issue

General Course Policies(授業の進め方)	14 lectures + 1 explanation of report assignment. Since the lecture materials will be distributed in advance, it is necessary to prepare for the lecture contents and consider the questions. Also, take revenge because you will be asked questions about points you did not understand in the previous lecture.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This lecture aims to achieve the following points.
	Couse objectives (具体的な授業の達成目標)	1. Understand semiconductor microfabrication technology. 2. Understand MEMS technology. 3. Understand the fusion technology of MEMS technology and semiconductor fine processing technology.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Report on process integration in microprocess: 100 points (at the end of the lecture) There will be no final examination.	
Assignment Instructions (授業外学習(予習・復習)の指示)	At the end of the lecture, let us know the next week's lecture schedule. Read and prepare materials corresponding to the schedule. Also, review the lecture contents so that you can ask questions before the lecture next week. As a preparatory study, prepare at least 4 hours a week.	
Keywords(キーワード)	Semiconductor microfabrication, micromachining, microsensor, microsystem	
Required Textbooks(教科書)	Prepare PDF files as materials for lectures. It will be distributed before the lecture starts.	
References/Recommended Reading(参考書)	・ Semiconductor Device 2nd Edition Basic Theory and Process Technology, S.M.G. ・ Basic of latest VLSI, written by Yuan Taur et al., Translated by Takeuchi Kiyoshi et al., Maruzen ・ Physics of Semiconductor Devices 3rd ed., S.M.Sze and K.W.Ng, Willey ・ ULSI Technology, C.Y.Chang and S.M.Sze, McGraw-Hill	
Notes(備考)		
Email(電子メールアドレス)	baba@cms.kyutech.ac.jp	

Course Name(科目名)	Advanced Digital Signal Processing		
Instructor Name(担当教員名)	Hiroshi Ochi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course deals with multi-media contents wireless transimisson schemes via IEEE802.11 WiLAN so that PHY layer and MAC layer are explained.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Not specified		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Digital modulation : Review	Review of linear modulation including OFDM and tranceiver architect
	2.	IEEE802.11 PHY layer fundamental	IEEE802.11g/a/n/ac Tranceiver architecture. MIMO System Fundam
	3.	MIMO Decoder	ZF/MMSE/ Blast linear MIMO decoder, ML type MIMO decoder
	4.	Lab1	MIMO decoder implementation by Matlab
	5.	Channel Capacity for MIMO System	Statistical analysis in terms of MIMO system under Raileigh fading c
	6.	Downlink Multi-User MIMO System	Downlink Multi-User MIMO system architecture and CSI feedback
	7.	Lab2	MU-MIMO system implementation by Matlab
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Students are supposed to prepare presentation material in each week content based on the hand-out textbook.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Cutting-edge advanced contents in terms of modern wireless communication system will be dealt with in this class.
	Couse objectives (具体的な授業の達成目標)	1. MIMO Wireless System Understanding for modern standard such as IEEE802.11ax and 5G Cellular 2. Computer simulation for verificaiton of above system's performance in terms of high data rate 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)"		Evaluation: Presentation 40%, Lab 30%, Class Discussion Contribution 30%
Assignment Instructions (授業外学習(予習・復習)の指示)		Review: Assignment is supposed to hand in next class Preparation: Need at least 4-hour for each week.
Keywords(キーワード)		Wireless LAN, PHY/MAC layer, MIMO
Required Textbooks(教科書)		Hand out
References/Recommended Reading(参考書)		Next Generation Wireless LANs, Eldad Perahia, Cambridge 2008
Notes(備考)		
Email(電子メールアドレス)		ochi@cse.kyutech.ac.jp

Course Name(科目名)	Advnaced Applied Superconductivity		
Instructor Name(担当教員名)	Edmund Soji OTABE		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The superconductivity phenomenon has the ideal property with no electrical resistance, while it is a nonlinear giant quantum phenomenon such as the Josephson effect. Taking advantage of such specialty, it is applied to power application equipments suitable for energy saving, medical equipment such as MRI, analog devices for communication, SQUID (superconducting quantum interferometer), and quantum computing. In this course, we will study physics such as diamagnetism, condensation energy, quantum effect, and Josephson effect, which are the basis of the superconductivity phenomenon.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Superconductivity is a phenomenon related to thermodynamic phase transition, but it is basically a giant quantum phenomenon. Hence, it is requred the basic skills of ″thermodynamics″, ″quantum mechanics″, ″electromagnetism″. In addition, it is preferable to have knowledge of physical properties such as free electron theory, because the difference from ordinary metals is discussed. Therefore, in order to take this course, students must take courses in the following faculties (keywords in parentheses). `` Modern physics I '' (wave equation, uncertainty principle, eigenvalue, expected value) `` Basic physics IIE '' (thermodynamic law) `` Electromagnetics I・ Seminar '' Study II ”(Superconductors, Magnetic Energy, Electromagnetic Induction) By completing this course, you will be able to acquire the basic knowledge of superconductivity phenomena necessary to complete the“ Special Course in Applied Superconductivity ”.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Basics of superconductivity (perfect	
	2.	Types of superconductors (Type 1 a	
	3.	Energy gap	
	4.	Superconducting electronic state	
	5.	London theory	
	6.	Ginzburg-Landau theory	
	7.	Quantization of magnetic flux	
	8.	Type 2 superconductor and upper cr	
	9.	Josephson effect (DC, AC)	
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		
General Course Policies(授業の進め方)	Lectures on the above items will be given mainly in textbooks, and necessary lectures on analytical mechanics,		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This lecture belongs to the Electronic Properties Module, and is expected to be applied to a wide range of fields such as electronics in order to achieve one of the learning and educational goals in the electronics field (1) ″Development of advanced technologies in the electronics field″. The goal is to learn the basics of superconductivity engineering. In particular,	
	Couse objectives (具体的な授業の達成目標)	1. 1. Understand the analysis and quantum mechanics, electromagnetism, and thermodynamics that are the 2. 2. Understand the essence of various unusual physical phenomena exhibited by the superconducting 3.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Since the purpose is not to absorb fragmentary knowledge, a test that gives answers in a short period of time does not fit in grade evaluation. Here, some tasks are assigned within the scope of the lecture, and the results are submitted as a report within the deadline and evaluated.		
Assignment Instructions (授業外学習(予習・復習)の指示)	Report will be giving assignments in a lecture, it is necessary to prepare materials for the next lecture. 4 hours a week is required as a preparatory study.		
Keywords(キーワード)	Superconductivity, perfect diamagnetism, energy gap, Ginzburg-Landau equation, quantized magnetic flux, type 2 superconductor, Josephson effect		
Required Textbooks(教科書)	Teruo Matsushita, Flux Pinning in Superconductors (Springer Series in Solid-State Sciences) 2014		
References/Recommended Reading(参考書)			
Notes(備考)			
Email(電子メールアドレス)	otabe@cse.kyutech.ac.jp		

Course Name(科目名)	Technology for Functional Materials		
Instructor Name(担当教員名)	Takashi Yasuda		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course provides an introduction to the principles and methods of thin film preparation, which play an essential role in synthesizing functional materials. This course covers kinetic theory of gas, crystal growth mechanism, and fundamental structures of several instruments for film preparation.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to the semiconductor synthesis module and is based on the elementary courses of physics and electronics, such as fundamental physics, electromagnetics, semiconductor engineering and electronic devices.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction	Overview of functional materials
2.	Kinetic theory of gas (1)	Maxwell-Boltzmann distribution
3.	Kinetic theory of gas (2)	Knudsen equation, mean free path
4.	Nucleation theory	
5.	Control of crystal growth	
6.	Vacuum deposition method (1)	Resistance heating evaporation
7.	Vacuum deposition method (2)	Electron-beam evaporation
8.	Sputtering method (1)	Glow discharge and DC sputtering
9.	Sputtering method (2)	RF sputtering and Magnetron sputtering
10.	Chemical vapor deposition (CVD) (1)	Thermal CVD
11.	CVD (2)	Effect of plasma and cyclotron resonance
12.	Epitaxial growth	
13.	Solution deposition technique	
14.	Hydrophobicity and hydrophilicity	
15.	Theory of spincoating	

General Course Policies(授業の進め方)		This course comprises lectures of fundamental theories cited above, daily tests for important formulei and reading/translation lessons using recent English technical articles.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal of this course is to master the fundamental knowledge of crystal growth and film preparation technique, which is related to the aim (1) "development of advanced technologies in electronics", as prescribed in the computer science and electronics field in our institute.
	Couse objectives (具体的な授業の達成目標)	1. Understand the relation between film preparation conditions and crystal growth. 2. Understand the characteristics of various film preparation techniques. 3. Read and interpret English articles of functional materials.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Course scores are evaluated from the result of daily tests (70%) and technical English reading (30%).
Assignment Instructions (授業外学習(予習・復習)の指示)		Students are expected to study for more than two hours to understand fundamental formulas in this course and to prepare for technical English reading practice. It is also helpful to read some textbooks of film preparation techniques that can be found in the university library. Some examples are listed below.
Keywords(キーワード)		kinetic theory of gas, nucleation, epitaxy, vacuum evaporation, sputtering, CVD, plasma, solution processing, crystallinity
Required Textbooks(教科書)		Not specified.
References/Recommended Reading(参考書)		(1) Akira Kinbara, Fundamental techniques of thin films, University of Tokyo Press (in Japanese). (2) Tatsuo Asamaki, Fundamentals of thin film preparation, Nikkan Kogyo Shimbun Ltd. (in Japanese).
Notes(備考)		
Email(電子メールアドレス)		yasuda@cse.kyutech.ac.jp

Course Name(科目名)	Advances on Soft Computing		
Instructor Name(担当教員名)	Kei Ohnishi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Soft computing is a framework of computational techniques to tackle with complex and ambiguous problems in the real world. In this class, you understand representative techniques in soft computing such as neural networks (NN), fuzzy systems (FS), and genetic algorithms (GA). In addition, you understand how to apply those techniques to problems through exercises.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	There is no subject for you to take in advance. However, you need knowledge of programming languages for exercises.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Soft computing	Lecture on soft computing
	2.	Traditional NN, FS, and GA	Lecture on traditional NN, FS, and GA (1)
	3.	Traditional NN, FS, and GA	Lecture on traditional NN, FS, and GA (2)
	4.	Traditional NN, FS, and GA	Lecture on traditional NN, FS, and GA (3)
	5.	Traditional NN, FS, and GA	Reading an English book of NN, FS, and GA (1)
	6.	Traditional NN, FS, and GA	Reading an English book of NN, FS, and GA (2)
	7.	Traditional NN, FS, and GA	Reading an English book of NN, FS, and GA (3)
	8.	Advanced NN, FS, and GA	Lecture on advanced NN, FS, and GA (1)
	9.	Advanced NN, FS, and GA	Lecture on advanced NN, FS, and GA (2)
	10.	Advanced NN, FS, and GA	Lecture on advanced NN, FS, and GA (3)
	11.	Advanced NN, FS, and GA	Exersice on advanced NN, FS, and GA (1)
	12.	Advanced NN, FS, and GA	Exersice on advanced NN, FS, and GA (2)
	13.	Advanced NN, FS, and GA	Exersice on advanced NN, FS, and GA (3)
	14.	Advanced NN, FS, and GA	Presentation on results of the exersice (1)
	15.	Advanced NN, FS, and GA	Presentation on results of the exersice (2)

General Course Policies(授業の進め方)		You take a lecture using slides and handouts and give round lectures based on a given English book and conduct an exercise and make a presentation on resluts of exercise.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	There are two objectives.
	Couse objectives (具体的な授業の達成目標)	1. You understand the concept and the need of soft computing and also representative soft computing 2. You understand how to solve problems using soft computing techniques.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)"		For the objective (1), you are assessed by materials for round lectures. This occupies 50 % of the whole score. For the objective (2), you are assessed by materials for presentation of exercise results. This occupies 50 % of the whole score.
Assignment Instructions (授業外学習(予習・復習)の指示)		You have to spend four hours a week for preparation. Since this course includes programming in the exrcise, you have to prepare prgramming environments by yourself.
Keywords(キーワード)		soft computing, computational techniques, flexibility, fuzziness, complexity.
Required Textbooks(教科書)		No textbook, but materials are provided in the course
References/Recommended Reading(参考書)		Introduing references in the course
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Science for Nanodevices		
Instructor Name(担当教員名)	Professor Yoshihito Maeda		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this course, we will give lectures on typical device applications from the foundation about new physical phenomena coming from the quantum mechanical behavior of electrons, spins, phonons and photons playing a part in advanced nanodevices.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This subject is closely related to the subjects as follows; ″Advanced Semiconductor Engineering″, ″Advanced Materials for Functional Materials″, Graduate School of Advanced Information Science and Technology, and it is the content which developed them. It is desirable that you have acquired basic physics such as ″Modern physics I″, ″modern physics II″, ″electromagnetism″, ″electronic physics″, ″solid physics / solid physical properties″, ″quantum mechanics″ Explain of them will be given as necessary.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Outline	What happens in mesoscopic region?
	2.	Physics in mesoscopic region	Basics on Electrical conduction, Ballistic conduction and diffusion of electron
	3.	Physics in mesoscopic region	Landauer's conduction law
	4.	Physics in mesoscopic region	Magnetoresistance effect, Quantum Hall effecct
	5.	Electronic properties	Electronic states in solids, Bloch states
	6.	Electronic properties	Physical processes involving electron waves, Band structure in solid
	7.	Single Electronic phenomena	Coulomb brokade, tunneling effect
	8.	Single Electronic phenomena	Single electron transitor and its opreration
	9.	Semiconductor nanostructures	Qunatum structures, and quantum states of electron
	10.	Semiconductor nanostructures	Two dimensional electron gases, High electron mobility transistor (HE
	11.	Semiconductor nanostructures	Quantum confimement effects, optical properties and their applicatio
	12.	Nanoscienece world and future	Nanoscienece world and the future 1 using VIDEO projection
	13.	Nanoscienece world and future	Nanoscienece world and the future 2 using VIDEO projection
	14.	Practical study	Practical study using manuscripts in English
	15.	Practical study	Practical study using manuscripts in English

General Course Policies(授業の進め方)		Lecture is carried out in a typical seminar style. We will impose a report task to measure its comprehension level. In the lecture, they are mainly conducted in English, and are advanced in consideration of students acquiring English technical terms. We will promote students' understanding by question-and-answer / discussion and let them understand essential concepts and research cases on nanodevice science. In addition, let us learn the current state and future of nano world by related video viewing. Make reading and summarize specialized English academic journals, and acquire technical terms and syntax. We welcome foreign students who have a strong interest in nano-scale devices and their science.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In this lecture, deepen the basic knowledge of the knowledge and technology of electronic engineering, information engineering, computer network (information communication) which is a common learning educational goal, and acquire expertise on application. (C-1) Achieve the following matters concerning deepening of knowledge on electronics and nurturing of applied academic ability.
	Couse objectives (具体的な授業の達成目標)	1. Students can understand and explain the characteristic physical phenomena and conduction in the mesoscopic system. 2. Students can understand and explain the physical phenomenon expressed in semiconductor nanostructures and the principle of device operation using it. 3. Students can comprehend the relevant English scientific papers by reading, and can summarize the
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Comprehensive evaluation of the results by grading the report (60%) on items (1) (2) and the reading summary (40%) of English academic papers on item(3).
Assignment Instructions (授業外学習(予習・復習)の指示)		Pre and post studies each for 1-2 hours are recommended.
Keywords(キーワード)		mesoscopic system, nanotechnology, devices, nanoscaled materials science, nanomaterials, semiconductor quantum structures
Required Textbooks(教科書)		Nothing in particular about a text book. During the lecture, materials and prints necessary for preparation / review will be distributed as appropriate.
References/Recommended Reading(参考書)		J. H. Davies: The Physics of Low-Dimensional Semiconductors (Cambridge Univeristy Press, Cambridge, 1998)
Notes(備考)		The lecture room may change due to lecture contents and exercises. E-mail will tell it each time. Professors academic backgroud may be known from Google Scholar: https://scholar.google.com/citations?user=WJCqqz8AAAAJ&hl=en&oi=ao
Email(電子メールアドレス)		maeda@cse.kyutech.ac.jp

Course Name(科目名)	Advanced magnetic recording technology		
Instructor Name(担当教員名)	Yasuhiro Fukuma		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	During the last two decades, the world's information is rapidly growing. The digital information is processed by electronic devices using semiconductor such as CMOS and stored in memory devices such as a hard disk drive (HDD). Spintronics (spin electronics) is an exciting research field that holds promise to build faster and more efficient devices to process and store the digital information, which is a new paradigm of electronics based on the spin degree of freedom of the electron. In this course, magnetic properties are lectured based on quantum mechanics and solid state physics. Also, magnetic and spintronic devices will be explained.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Familiarity with quantum mechanics and solid state physics		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction & origin of Magnetism	Classical and Quantum approach to magnetism : Magnetic Fields & F
	2.	Classification of Magnetic materials &	Dia & para magnetic, Ferromagnetic, Antiferromagnetic materials
	3.	Magnetic measurements & technique	Measurement of Field strength, Torque, Magnetic force Microscopy,
	4.	Magnetic Anisotropy & Nanomagnetis	Magneto crystalline Anisotropy, Magnetorestriction, Shape and Induc
	5.	Micromagnetism and Magnetization F	Domain formation, Domain walls & length scales of domains, Stoner -
	6.	Micromagnetism and Magnetization F	Free energy of magnetic systems : Exchange, MCA, Demagnetizing, Z
	7.	Magnetization dynamics	Landau – Lifshitz –Gilbert Equation, Precessional &, Relaxation terms
	8.	Group discussion 1/ Student presen	Magnetic quantities measurement techniques/ Micromagnetism & LL
	9.	Spintronics – Magnetic recording	Principles of magnetic recording, Write head, Read Head, Recording
	10.	Advancements in recording technolo	Fundamentals of spintronics, Anisotropic magnetoresistance, GMR, T
	11.	MRAM 1	Field mode MRAM : Astriod, toggle mode MRAM, Switching energy ba
	12.	MRAM 2	Spin–Transfer Torque mode MRAM: concept of spin polarization, sp
	13.	Materials and Quantification of Spin	Role of perpendicular (uniaxial) and cubic anisotropic materials, Non
	14.	Memory cell operartion	Switching characteristics, probabilities, break down voltage, Write an
	15.	Group discussion 2/ Student presen	Modelling MRAM device using Micromagnetic simulations : Effect sha

General Course Policies(授業の進め方)		lecture and group discussion
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students will be able to understand fundamental principles of magnetism and spintronic devices
	Couse objectives (具体的な授業の達成目標)	1. Understand fundamentals of magnetism 2. Understand fundamentals of magnetic materials 3. Understand magnetic applications
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)"		attendance, homework, presentation in group discussion
Assignment Instructions (授業外学習(予習・復習)の指示)		There will be one homework assignment per day announced at the end of the class.
Keywords(キーワード)		ferromagnetism, magnetic anisotropy, magnetization curve, magnetoresistance, spin Hall effect
Required Textbooks(教科書)		None required
References/Recommended Reading(参考書)		Soshin Chikazumi, "Physics of Ferromagnetism"
Notes(備考)		
Email(電子メールアドレス)		magnet@kit-fukuma.allbiz.jp

Course Name(科目名)	Advanced Lecture on Wireless Mobile Networks		
Instructor Name(担当教員名)	TSUKAMOTO Kazuya		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	With the recent development of various user terminals such as smartphones, sensors, and vechicles, a variety of wireless moible networks including ad-hoc network is built, thereby providing diverse wireless services. In this course, Instructor explains the design policy and behavior of system and communication protocol working on these networks. Also, recent ternds of wireless communication technologies including cognitive radio is investigated to understand the desing policy for the next wireless communication systems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course assumes that the studensts take courses of "Network communication basic" and "Network architecture" (subjects of Department of Computer Science and Electronics) and their related subjects. Furthermore, to deeply understand the information communication network, taking of "advanced network management" and "Advanced lecture on network design" is recommended in addition to this courese.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction of wireless mobile netwo	Introduce the latest trend of wireless mobile network
	2.	Introduction and explanation of alloca	Introduce the duties for each students and explain the allocated pap
	3.	Changes in wireless mobile network (	
	4.	Mobility management protocol (e.g., M	
	5.	Trends of cognitive radios (I)	
	6.	Trends of cognitive radios (II)	
	7.	Trends of sensor networks	
	8.	Trends of body area network (I)	
	9.	Trends of body area network (II)	
	10.	Trends of new network technology (I	
	11.	Ad-hoc network for large-scale netw	
	12.	Presentation (I)	
	13.	Presentation (II)	
	14.	Presentation (III)	
	15.	Presentation (IV)	
General Course Policies(授業の進め方)	Until 11th class, the instuctor explain in the lecture style. After that, the students need to hand in reports and		
Course Objectives (授業の達成目標) — Introduction to Couse Objectives (授業の達成目標の解説)	In this course, to understand the concrete realising way of the advanced mobile network (one of the course objectives of computer science), the goal is to acquire basic knowledge about the current status of wireless mobile networks and their future trends.		
Course Objectives (授業の達成目標) — Couse objectives (具体的な授業の達成目標)	1. Understanding the history and status of wireless mobile network 2. Understanding the system architecture and communiation protocol of wireless mobile network 3. Understanding the world trends of research and development of wireless mobile network		
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Evaluates grades with reports by individual submittion and group presentations. About reports and presentations, materials submitted before the deadline will be evaluated. Regarding presentations, presentation materials and Q & A sessions will also be evaluated. After the presentation, reports will be evaluated, finally.		
Assignment Instructions (授業外学習(予習・復習)の指示)	Lecture materials will be uploaded to moodle in advance, so download and print them before the lecture and bring them to the lecture. You can download it to your laptop or tablet device and listen to the lecture, or prepare to take notes for necessary items. Be sure to read the materials before the lecture (preparation) and take notes as needed during the lecture. After the lecture, review the content, and then examine the English papers related to the lecture content for each group determined in advance, summarize the content, and report it in a report and presentation. Finally, consider the relationship between the textbooks and the contents that you have individually understood, and then report them. In doing so, review the contents of the lecture and consider future directions from a broad perspective based on the information obtained from the textbooks.		
Keywords(キーワード)	Wireless mobile network, cellular network, WiMAX, mobility management, Wi-Fi Direct, sensor network, vehicular network, cognitive radio		
Required Textbooks(教科書)	Tsukamoto Kazuya, http://www.kyoritsu-pub.co.jp/bookdetail/9784320009158		
References/Recommended Reading(参考書)			
Notes(備考)	N/A		
Email(電子メールアドレス)	tsukamoto@cse.kyutech.ac.jp		

Course Name(科目名)	Advanced Organic Electronics		
Instructor Name(担当教員名)	Shuichi NAGAMATSU		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this lecture, students will learn the basics of optoelectronic properties of organic semiconductor molecules and conductive polymers and device physics based on knowledge of inorganic semiconductors. Students will also read relevant English academic papers and discuss the background of organic electronics and future developments.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture belongs to the Electronic Materials Module and deals with basic physical properties and device physics of organic semiconductor materials, which is one of the next generation semiconductor materials.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Basis of Semiconductor Devices	
	2.	Organic Semiconductor Materials	
	3.	Conjugated Polymers	
	4.	Organic Light-emitting Diodes	
	5.	Organic Photovoltaics	
	6.	Organic Transistors	
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		a seminar format
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This lecture aims to achieve the learning / educational goals in the field of electronics and information engineering (1) "Development of advanced technologies in the field of electronics" in order to achieve the next generation electronics technology with features such as printed flexible wearables. The goal is to learn the basics of electronics
	Couse objectives (具体的な授業の達成目標)	1. understandings for optoelectronics properties of organic semiconductor molecules 2. understandings for basics of device physics of organic semiconductor 3. understandings for English papars in field of Organic Electronics
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)"		attendance and reports
Assignment Instructions (授業外学習(予習・復習)の指示)		4 hours a week for a preparatory study.
Keywords(キーワード)		organic semiconductor, conjugated polymers, device physics
Required Textbooks(教科書)		none
References/Recommended Reading(参考書)		Organic Semiconductor Devices
Notes(備考)		
Email(電子メールアドレス)		nagamatu@cse.kyutech.ac.jp

Course Name(科目名)	Advanced electronic material engineering		
Instructor Name(担当教員名)	Yoshikazu TERAI		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In the current IoT society, various devices using electronic and optical materials are used. These devices are developed by effectively utilizing the physical properties of electronic materials. The physical properties of each electronic material are mainly derived from its electronic structure. The electronic structure can be obtained by first-priciple calculation. In this course, you learn the basics of first-principles calculation and the calculation method using the code to understand the electronic structure of various electronic materials.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	In this course, students learn the basic physical properties of electronic materials and the methods of first-principle calculations. Basic knowledge such as quantum physics, solid state physics and semiconducting physics is desirable, but explanations will be given as necessary.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction (What is MateriApps, Quantum Espresso?	
	2.	Band calculation of Si (scf.in, nscf_band.in, band.in)	
	3.	How to determine the calculation conditions	
	4.	Band calculation of Si, Ge, C	
	5.	Band calculation of GaAs, GaN, ZnSe	
	6.	Calculation of Charge density, Total DOS and Partial DOS of Si	
	7.	Calculation of Phonon band and Raman, IR peak positions of Si	
	8.	Band structure, Fermi surface of Al, Cu, and Spin polarization of Fe	
	9.	Calculation code using cif file using TiO2 as an exampl	
	10.	Scf calculation with VC-relax and relax of lattice	
	11.	Calculation of band structure in selected material	
	12.	Calculation of TDOS and PDOS in selected material	
	13.	Presentation of obtained results in selected material	
	14.	Presentation of the latest topics on electronic materials (1): Electronic device	
	15.	Presentation of the latest topics on electronic materials (2): Optical device	

General Course Policies(授業の進め方)		This course will be taught in Japanese. The course materials are mainly given in English.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This lecture is aimed at learning in the field of physical and information engineering (C) “Basic science in information science, electronic physics, and biotechnology. The goal is to acquire the basics of electronic material engineering to achieve ″having professional ability to use″.	
	Couse objectives (具体的な授業の達成目標)	1. Understand the basic properties and physical properties of semiconductors, dielectrics, magnetic materials, and metals. 2. Understand the basics of first-principles calculation. 3. Make a first-principles calculation code and calculate the electronic structure of various electronic materials.	
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)		The report (75%) and presentation 25%).	
Assignment Instructions (授業外学習(予習・復習)の指示)		Before the class, the students should a preparatory study for 4 hours a week.	
Keywords(キーワード)		Semiconductor, dielectric, magnetic material, metal, device, first-principles calculation	
Required Textbooks(教科書)		Nothing special. Distribute necessary materials as needed.	
References/Recommended Reading(参考書)			
Notes(備考)			
Email(電子メールアドレス)		terai@cse.kyutech.ac.jp	

Course Name(科目名)	Advanced Algebra I		
Instructor Name(担当教員名)	Makoto Tagami		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	As a foundation of algebraic systems, the notion of a group is introduced and the basis is lectured. Specifically, we introduce symmetric groups and alternative groups as an basic example of groups and lecture the calculation method of permutations, cyclic permuations and signs of permuations. Furthermore, we lecture the fundamental theorems of isomorphisms and homomorphisms between groups, and lecture the structuretheorems such as the sylow theorem and the structure theorem of abelian		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	As a preparation for Advanced Algebra II, group theory which is the most fundamental notion in algebra is lectured.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Sets and maps	
	2.	The definition of a group	
	3.	Subgroups and residue classes	
	4.	Normal subgroups and quotient groups	
	5.	Symmetric groups and alternating groups, calculations of permuatations, signs of permuations	
	6.	Cyclic groups and decompositions into cyclic permutations	
	7.	Homomorphism and the fundamental theorem	
	8.	Actions of groups and groups with operations	
	9.	The sylow theorem	
	10.	Direct products of groups	
	11.	The structure theorem of finitely generated abelian groups, I	
	12.	The structure theorem of finitely generated abelian groups, I	
	13.	Solvable groups and nilpotent groups	
	14.	Composition series	
	15.	The Krull-Schmidt theorem	

General Course Policies(授業の進め方)		Some reports are imposed along the above class contents.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. The objective of the class is to acquire 'fundamental knowledge required in information science, information engineering and other areas' presented in the common 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		It is comprehensively evaluated by reports.
Assignment Instructions (授業外学習(予習・復習)の指示)		In this class, the calculation and property of specific groups play an important role. It is important to review he lectures properly and understand the contents steadily. Participants is required to spend at least 4 hours per a week for a preparation of class.
Keywords(キーワード)		group, symmetric group, alternating group, the Sylow theorem, structure theorem of finite abelian groups, slovable group, compostion series, the Krull-Schmidt theorem
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Algebra, Hiroshi Nagao, Asakura shoten, in Japanese
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Algebra II		
Instructor Name(担当教員名)	Makoto Tagami		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	As a foundation of algebraic systems, the notions of a ring and a filed are introduced and the basis is lectured. We lecture the notions of ideals and redisue rings and introduce the fundamental theorem of homomorphisms of rings. Furthermore we introduce the total quotient ring which is a generalization of the construction of rings of rational numbers from the ring of integers, unique factorization domain which is an abstraction of the property of factorization of integers, the theory of elementary divisors which is the theory of finitely generated module over pricipal ideal domains, and we lecture linear algebra over fileds. Finally we lecture the notion of extension of fields, algebraic closure, the construction of finite fileds and the property of finite fields.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Under the contents of Advanced Algebra I, ring theory which is the most fundamental notion in algebra is lectured.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Rings and fields	
	2.	Ideals and residue rings	
	3.	The fundamental theorem of homomorphisms	
	4.	Prime ideals and maximal ideals	
	5.	Direct sums of rings	
	6.	Total quotient rings	
	7.	Unique factorization domain	
	8.	R-modules	
	9.	Modules over principal ideal domains	
	10.	Linear algebra over fields	
	11.	Jordan normal forms and the theory of elementary divisors	
	12.	Characteristic	
	13.	The notion of extensions	
	14.	The existence and the uniqueness of algebraic closure	
	15.	Constructions of finite fields and its property	

General Course Policies(授業の進め方)		Some reports are imposed along the above class contents
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The objective of the class is to acquire 'fundamental knowledge required in information science, information engineering and other areas' presented in the common course objective (B) of Graduate School of Computer Science and Systems Engineering.
	Couse objectives (具体的な授業の達成目標)	1. To understand the notion of rings and to judege whether an algebraic structure has a ring structure. 2. To understand the notions of ideals and basic calculations on ideals 3. To understand the fundamental theorem of homomorphisms and basic calculations of homomorphisms. 4. To understand the notions of prime ideals and maximal ideals and to judge whether an ideal is a prime ideal or a maximal ideal. 5. To reconstruct the theory of linear algebra Under the notion of R-modules .
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		It is comprehensively evaluated by reports.
Assignment Instructions (授業外学習(予習・復習)の指示)		In this class, the calculation and property of finite fields play an important role. It is important to review he lectures properly and understand the contents steadily. Participants is required to spend at least 4 hours per a week for a preparation of class.
Keywords(キーワード)		ring theory, number theory, finite fields
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Algebra, Hiroshi Nagao, Asakura shoten, in Japanese
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Optimization Theory		
Instructor Name(担当教員名)	Eitaku Nobuyama		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course deals with the fundamental optimization theory and the optimization methods for continuous-variable problems. It starts with the optimality conditions for non-linear optimization problems, then explores some fundamental optimization methods for optimization problems without or with constraints.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to Module "Optimization Module."		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	What is Optimization Theory?
	2.	Mathematical preliminary	Mathematical preliminary and problem formulation
	3.	Optimality condition 1	Optimization problems without constraints
	4.	Optimality condition 2	Optimization problems with equality constraints
	5.	Optimality condition 3	Optimization problems with ineequality constraints
	6.	Optimization method 1	Golden section method
	7.	Mid-term exam	Midterm exam and its review
	8.	Optimization method 2	Convergence rate, Steepest descent method
	9.	Optimization method 3	Newton's method, Quasi-Newton's method
	10.	Optimizaiton method 4	Trust region method
	11.	Optimization method 5	Penalty function method, Barrier functin method
	12.	Optimization method 6	Sequential quadratic programming
	13.	Optimization method 7	Convex programming
	14.	Duality	Dual problem, Duality theorem
	15.	Optimization method 8	Support vector machine

General Course Policies(授業の進め方)	This course will be taught in a didactic manner in Japanese.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	At the end of the course, participants are expected to understand optimality conditions and explain fundamental optimization methods for non-linear optimization problems.
	Couse objectives (具体的な授業の達成目標)	1. Describe optimality condtions for non-linear optimization problems. 2. Explain optimization methods for optimizaiton problems without constraints. 3. Explain optimization methods for optimizaiton problems with constraints.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Grading will be decided based on mid-term exam and term-end report.	
Assignment Instructions (授業外学習(予習・復習)の指示)	Participants are expected to study in advance for the next class and review what was learned in class. They are expected to take more than 4 hours in a week for preparation.	
Keywords(キーワード)	optimization, optimality condition, non-linear programming, convex programming, duality	
Required Textbooks(教科書)	Will be introdued in the class.	
References/Recommended Reading(参考書)	Will be introdued in the class.	
Notes(備考)		
Email(電子メールアドレス)	nobuyama@ces.kyutech.ac.jp	

Course Name(科目名)	Advanced Topics in Image Processing		
Instructor Name(担当教員名)	Takeshi Saitoh		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Lectures on basic and advanced algorithms related to image processing.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is desirable to have knowledge on image processing and pattern recognition, such as "Statistics and Data Analysis", "Image Information Processing", and "Multimedia Engineering" at undergraduate schools.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	machine learning	
2.	deep learning	
3.	traditional (hand-craft) approaches	
4.	image processing	
5.	facial image processing	
6.	recent topics	
7.	presentations	
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		This class is conducted in a lecture style. Basic image processing algorithms in each field and papers published
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. In this lecture, the common educational education goals of the Graduate School of Information Engineering (B) "Basic academic skills required in information science and engineering and various 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Comprehensive evaluation based on the contents of the exercises (60%) and reports (40%).
Assignment Instructions (授業外学習(予習・復習)の指示)		Lecture materials will be released in advance in Moodle. Read and prepare for the materials. In addition, a report will be imposed as a review. 4 hours a week as a preparatory study.
Keywords(キーワード)		Image processing, pattern recognition
Required Textbooks(教科書)		Distribute materials in the class.
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		saitoh [at] ces.kyutech.ac.jp

Course Name(科目名)	Algebraic Combinatorics		
Instructor Name(担当教員名)	Makoto Tagami		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this class, we introduce coding theory through algebraic combinatorics. We start with a basis of number theory, after that, we construct interesting combinatorial structure. Furthermore we give a construction of a code fixed a code length and having the maximal error correcting ability by using the combinatorial structures. We introduce how mathematics can be applied to coding theory in infomation science.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The class is an information subject (Elective course) in Master's program. We lecture from a basis of discrete mathematics to applications to information science. As a background knowledge for the class, it is disirable that participants are familiar with linear algebra, but more advanced linear algebra such as linear spaces over finite fields is lectued in the class at any time if necessary.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Sets, equivalent classes, classificatic	
	2.	functions and algebraic systems	
	3.	Introduction to number theory, I	
	4.	Introduction to number theory, II	
	5.	Introduction to number theory, III	
	6.	GCD of polyomials	
	7.	A construction of finite fields and its	
	8.	Finite geometry and designs, I	
	9.	Finite geometry and designs, II	
	10.	A basis of coding theory	
	11.	Linear codes	
	12.	Encoding and decoding of linear code	
	13.	The Hamming bound and perfect cod	
	14.	Cyclic codes, I	
	15.	Cyclic codes, II	

General Course Policies(授業の進め方)		Some reports are imposed along the above class contents.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. The objective of the class is to acquire 'fundamental knowledge required in information science, 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		It is comprehensively evaluated by reports.
Assignment Instructions (授業外学習(予習・復習)の指示)		In this class, the calculation and property of finite fields play an important role. It is important to review he lectures properly and understand the contents steadily. Participants is required to spend at least 4 hours per a week for a preparation of class.
Keywords(キーワード)		number theory, finite fields, coding theory
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Mathematics of codes and cryptograpy, Ryo Fujiwara and M.Jinbo, Kyoritsu shuppan, in Japanese
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Stochastic numerics		
Instructor Name(担当教員名)	Yoshio Komori		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	We deal with numerical methods for stochastic differential equations (SDEs). SDEs are an excellent tool to describe physical phenomena in which random effects play an important role. They can be used to model bio-chemical reactions, turbulent diffusion and so on. However, there are not so many cases in which the analytical solution can be obtained. For this, we need numerical methods to get approximate solutions for SDEs. In the present class, we start with an introduction to SDEs and we deal with well-known numerical methods for SDEs and related topics.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Students who take this class are expected to have fundamental knowledge about probability, stochastic processes, differential equations and numerical analysis. However, they do not need the advanced knowledge of these subjects as auxiliary explanations will be given in the class.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	①② Introduction, probability spaces and random variables	
	2.	③④ Limit theorems, stochastic processes	
	3.	⑤⑥⑦ Stochastic integrals, Ito's theorem	
	4.	⑧⑨⑩ General SDEs, analytically solvable SDEs	
	5.	⑪⑫⑬ Numerical methods for SDEs	
	6.	⑭⑮ Applications of SDEs, stability in SDEs	
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lectures about the topics listed above will be given in the class.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	By taking this class, students will be able to get knowledge about SDEs and numerical methods. As a result, they will be able to apply the methods to their own problems in research.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Students are evaluated by reports which they are requested to submit.
Assignment Instructions (授業外学習(予習・復習)の指示)		It is recommend that students read notes after each class to check their understanding. Students may need to spare about one hour for it except the class. Of course, the length of the time to spare will depend on each of the students.
Keywords(キーワード)		SDE, numerical method, approximate solution, numerical stability, stochastic Runge–Kutta method
Required Textbooks(教科書)		Materials will be handed out to students in the class.
References/Recommended Reading(参考書)		Gard, T.C. (1988), Introduction to Stochastic Differential Equations, Marcel Dekker. Kanekiyo, Y. (2017), Stochastic differential equations and its applications (in Japanese), Morikita.
Notes(備考)		
Email(電子メールアドレス)		komori@ces.kyutech.ac.jp

Course Name(科目名)	Advanced Discrete Algorithms		
Instructor Name(担当教員名)	Toshiki Saitoh		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Many actual problems on computers are modeled as discrete structures, for example graphs, strings, and so on, and we treat the problems with discrete optimization problems. However, if we use naive algorithms for these problems, we cannot solve them realistically by the huge amount of combinations. Therefore, it is important to design efficient algorithms for them. In this course, we study advanced algorithm design and analyze mtehod to solve the optimization problems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to algoirthm design and optimization modules and we study advanced discrete algorithm design and analyzing methods. We require basic knowledge of graphs and algorithm design before taking this course.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction of this course	
2.	Branching (1)	Algorithm design and correctness
3.	Branching (2)	Complexity analysis
4.	Branching (3)	Advanced algorithms: Measure & Conquer
5.	Branching (4)	Exercises
6.	Dynamic programming (1)	Algorithm design
7.	Dynamic programming (2)	Advanced algorithms: Inclusions and exclusions
8.	Dynamic programming (3)	Complexity analysis
9.	Dynamic programming (4)	Exercises
10.	Treewidth and Frontier-based search (1)	Definintion of treewidth and dynamic programming
11.	Treewidth and Frontier-based search (2)	Computing tree decompositions
12.	Treewidth and Frontier-based search (3)	ZDD and frontier-based search
13.	Treewidth and Frontier-based search (4)	Applications of frontier-based search and implementations
14.	Treewidth and Frontier-based search (5)	Exercises
15.	Conclusions	

General Course Policies(授業の進め方)		We use lecture and exercise style in the class. We give some exercises and homeworks to test understanding.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	We study advanced algorithm design and analysing methods. And then we learn how to solve discrete optimization problems related to actual and social problems.
	Couse objectives (具体的な授業の達成目標)	1. We can design algorithms by using each algorithm design methods, branching, dynamic programming, and frontier-based search. 2. We can develop algorithms for discrete optimization problems by selecting suitable algorithm techniques. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		We give some homeworks to design and analyze algorithms for each algorithm technique. We check your understanding by examination and/or making presentations about your algorihtms . Report: 60 – 70%, Examination: 30 – 40%
Assignment Instructions (授業外学習(予習・復習)の指示)		You can see the materials of this courses on Moodle. You take preparations 2 hours and reviews 2 hours by using them. You have to try to solve exercises to understand the details. We will upload these exercises on Moodle.
Keywords(キーワード)		Discrete algorithms, data structures, branching, dynamic programming, frontier-based search, complexity theory
Required Textbooks(教科書)		Nothing (we will give you some materials on Moodle.)
References/Recommended Reading(参考書)		・F.V. Fomin, D. Kratsch, Exact Exponential Algorithms, Springer, 2010. ・湊 真一(編), 超高速グラフ列挙アルゴリズム, 森北出版, 2015. ・Cygan et al., Parametarized Algorithms, Springer, 2015.
Notes(備考)		
Email(電子メールアドレス)		toshikis@ces.kyutech.ac.jp

Course Name(科目名)	Advanced Optical Systems and Applications		
Instructor Name(担当教員名)	Masanori Takabayashi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Lectures on expert knowledges and hot topics about optical systems and applications which are widely used in our life are given. Especially, we provide explanations to understand the relationships between expert knowledges on optics and how to apply them in our life by focusing on familiar applications such as optical recording, optical communication and optical imaging systems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to Applied Optics Module. Having the knowledge on optics and electromagnetics is encouraged, but it is not strictly required.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	Overview	
2.	Wave optics (1)	Wave equation, Plane wave, Spherical wave
3.	Wave optics (2)	Diffraction, Wave propagation, Fourier transformation by lens
4.	Holography (1)	Fundamental of holography, Volume holography
5.	Holography (2)	Digital holography, Computer generated holography
6.	Optical information processing (1)	Imaging optics
7.	Optical information processing (2)	Optical filtering
8.	Optical memory (1)	History and principle of conventinal optical memory
9.	Optical memory (2)	Recent progress of optical memory
10.	Optical communication (1)	History and principle of conventinal optical fiber communication
11.	Optical communication (2)	Recent progress of optical fiber communication
12.	Optical imaging (1)	History and principle of conventional optical microscope
13.	Optical imaging (2)	Recent progress of optical microscope: nonlinear optical microscope
14.	Optical imaging (3)	Recent progress of optical microscope: quantitative phase imaging
15.	Summary	

General Course Policies(授業の進め方)		Lecture format. Discussions will be held as necessary to deepen understanding.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	To understand fundamental of optics and how optics is applied for optical applications used today.
	Couse objectives (具体的な授業の達成目標)	1. To understand fundamental of wave optics. 2. To understand history and principle of conventinal optical memory and recent progress. 3. To understand history and principle of conventinal optical communication and recent progress. 4. To understand history and principle of conventinal optical imaging and recent progress.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		20%: Homework, 80%: Final report
Assignment Instructions (授業外学習(予習・復習)の指示)		Download and read lecture materials in Moodle, and look up words in references. 4 hours/week should be set for preparation.
Keywords(キーワード)		Wave optics, Fourier optics, Holography, Optical memory, Optical communication, Optical imaging
Required Textbooks(教科書)		Not specified.
References/Recommended Reading(参考書)		Yoshimasa Kawata, "Beginner's Guide to OPTICS," Kodansha (2014). (in Japanese) J. W. Goodman, "Introduction to Fourier Optics, Third Edition," Roberts & Co. Publishers (2005)
Notes(備考)		
Email(電子メールアドレス)		takabayashi@ces.kyutech.ac.jp

Course Name(科目名)	Optimization Algorithms		
Instructor Name(担当教員名)	Eiji Miyano		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Many optimization problems in Computer Engineering, Computer Science and System Engineering has the discrete structures and thus they often are formalized as "combinatorial" optimization problems. Recently, the size of data and/or information is increasing. Thus, to processing and/or deal with the large amount of information, it is important to acquire the knowledge of the standard algorithm design paradigms and efficient data structures. This course develops standard techniques use in the design and analysis of algorithms, with an emphasis of problems in combinatorial optimization problems arising in computing applications. Example applications are drawn from graph/network problems, artificial intelligence, combinatorial geometry, computational biology and so on.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to "Algorithm design" and "Optimization" modules. This course is concerned with issues that arise in the design for solving combinatorial optimization problems. The prerequisite include courses in discrete mathematics, discrete structures, the design of simple algorithms, basic data structures, and computational complexity.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	Course guidance
	2.	Asymptotic notation and analyzing time complexity	Big O, big Omega, small o, small omega, Theta-notations
	3.	Review on designing and analyzing algorithms	simple algorithm design techniques
	4.	Review on data structures	basic data structures
	5.	Review on computational complexity	polynomial time solvability, NP-completeness, NP-hardness
	6.	Combinatorial optimization problems and approximation	Combinatorial optimization problems and approximation
	7.	Designing approximation algorithms (1)	greedy algorithms, local search algorithms
	8.	Designing approximation algorithms (2)	dynamic programming
	9.	Designing approximation algorithms (3)	LP-base algorithms, LP-relaxation
	10.	Designing approximation algorithms (4)	primal-dual algorithms
	11.	Online computation model	online computational model
	12.	Competitive ratio and designing online algorithms	competitive ratio, online algorithms
	13.	Designing randomized algorithms	randomized algorithms
	14.	Designing parallel algorithms	parallel algorithms
	15.	Conclusion	
General Course Policies(授業の進め方)	Lectures with slides		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Upon completion of this course, students will be able to do the following: (1) Analyze the asymptotic performance of algorithms and demonstrate a familiarity with major algorithms and data structures. (2) Apply important algorithmic design paradigms and methods of analysis. More concretely, students who complete the course will have demonstrated the ability to do the following:	
	Couse objectives (具体的な授業の達成目標)	1. Formalize engineering applications as combinatorial optimization problems 2. Describe the approximation, online, randomized, and parallel algorithm paradigms. 3. Design and analyze efficient algorithms for combinatorial optimization problems.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Class attendance, discussion and quizzes (20 – 30%). Mid and final reports (70 – 80%)		
Assignment Instructions (授業外学習(予習・復習)の指示)	Students have to find at least four hours for preparation/review of classes in a week.		
Keywords(キーワード)	combinatorial optimization problems, algorithm design, data structures		
Required Textbooks(教科書)	We will not follow a single textbook as is fairly common with graduate-level courses. The lecture slides will be main resources.		
References/Recommended Reading(参考書)	(1) T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein. Introduction to Algorithms, 2nd Ed., MIT Press. (2) J. Kleinberg and E. Tardos. Algorithm Design, Addison Wesley. (3) M.R. Garey and D.S. Johnson. Computers and Intractability, W.H. Reeeman and Company. (4) V.V.Vazirani. Approximation Algorithms, Springer. (5) D.P. Williamson and D.B. Shmoys. The Design of Approximation Algorithms, Cambridge University Press. (6) M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press. (7) A. Borodin and R. El-Yaniv. Online Computation and Competitive Analysis, Cambridge University Press. (8) Proceedings of STOC, FOCS, SODA, ESA and etc.		
Notes(備考)			
Email(電子メールアドレス)	miyano@ces.kyutech.ac.jp		

Course Name(科目名)	Advanced Optical Physics		
Instructor Name(担当教員名)	OKAMOTO Takashi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This lecture provides the basis of high-speed, high-precision optical wave sensing technology, which occupies an important position in various measurement technologies. The mechanism of the laser, the operation method of light, and various interference measurement methods are described in an orderly manner. Application examples will also be introduced to deepen understanding.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to the optical application module and relates to the measurement application of laser technology. Therefore, it is desirable that there is a basic knowledge about light and electromagnetic waves, but not necessarily essential. The subjects related to this lecture include physical subjects such as electromagnetics and optics.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Orientation	
	2.	Basics of lasers	
	3.	Interaction of light and atoms	
	4.	Optical resonators	
	5.	Coherence of light	
	6.	Basic properties of light	
	7.	Manipulation of light	
	8.	Fundamentals of interferometry	
	9.	Methods for improving accuracy	
	10.	Holographic measurement	
	11.	Laser speckle measurement	
	12.	Laser Doppler measurement	
	13.	Scattering of light	
	14.	Biological measurement	
	15.	Summary	
General Course Policies(授業の進め方)	Lecture-based teaching		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The aim of this lecture is to understand the basic properties of laser light and the principles of various measurement methods using lasers.	
	Couse objectives (具体的な授業の達成目標)	1. To understand the mechanism of laser systems 2. To understand the principles of interferometry and interferometric measurements 3.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Evaluate the final report submitted at the end of the course		
Assignment Instructions (授業外学習(予習・復習)の指示)	Give an assignment for each class.		
Keywords(キーワード)	laser, interferometry, holography, speckle, Doppler effect		
Required Textbooks(教科書)			
References/Recommended Reading(参考書)	Yariv, Optical Electronics, Oxford University Press		
Notes(備考)			
Email(電子メールアドレス)	okamoto@ces.kyutech.ac.jp		

Course Name(科目名)	System Design		
Instructor Name(担当教員名)	Jun Kobayashi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course deals with a method for devising a system by design thinking, idea sketching, and prototyping. It enhances the development of students' skill in system design and digital fabrication.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	By taking this course, you can acquire the ability to design systems on the basis of your knowledge about "electrical and electronic circuits" and "control theory" that you have learned in your undergraduate school. It is desirable that you have completed subjects related to "Electrical and Electronic Circuits" and "Control Theory"; however, the required minimum knowledge will be taught in this class.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Guidance	
	2.	Drawing for creation	
	3.	Physical Computing 1	
	4.	Physical Computing 2	
	5.	Physical Computing 3	
	6.	Idea Sketching	
	7.	Design Thinking 1 (quick review)	
	8.	Design Thinking 2 (quick review)	
	9.	Design Thinking 3	
	10.	Prototyping 1	
	11.	Design Thinking 4	
	12.	Prototyping 2	
	13.	Design Thinking 5	
	14.	Prototyping 3	
	15.	Test & Presentation	

General Course Policies(授業の進め方)		In this course, students will cooperate with team members to devise a system, make a prototype, and give a presentation about their system. This course will be taught in Japanese and English. Students are required to discuss in English in their team because there might be some international students in your team.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	By the end of the course, students should be able to do the following:
	Couse objectives (具体的な授業の達成目標)	1. Describe and explain process of design thinking and idea sketching 2. Describe the mechanism of digital machine tools and use them 3. Make a prototype of a system they devised 4. Exchange constructive opinions and idea with team members
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Your final grade will be calculated according to the following process: Presentation (60%), Evaluation by team members (20%), and test (20%).
Assignment Instructions (授業外学習(予習・復習)の指示)		You must spent 4 hours a week for preparatory learning.
Keywords(キーワード)		Design Thinking, Idea Sketching, Prototyping, Digital Machine Tools
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		You need to bring your own laptop every time. You also need to buy and bring an ESP32 development board. We will organize teams at the first session. Therefore, it is not acceptable to join the class from the second and subsequent sessions. If you can not attend the first session, please contact with me in advance. The maximum number of students is 12 due to the limited classroom space. If there are applicants more than 12, we will select the students by negotiation or in a lottery.
Email(電子メールアドレス)		jkoba@ces.kyutech.ac.jp

Course Name(科目名)	Advanced control theory for biological systems		
Instructor Name(担当教員名)	Nakakuki, Takashi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In recent years, control engineering has been applied not only to mechanical and electrical systems, but also to biological and molecular systems. The dynamics of biological and molecular systems can be considered, for example, as a temporal change in the molecular concentration of proteins, mRNA, DNA, etc. in the system. In this lecture, after reviewing some basics of mathematics, the students will learn how biological and molecular systems can be treated by using ordinary differential equations and control theory.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The students will deeply consider the application of "control theory" to biological and molecular systems. Therefore, it is desirable, but not essential, to have basic knowledge of system control theory such as classical/modern control theory.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Mathematical modeling with chemica	Some basic knowledge about mathematical modeling with chemical master equation.
	2.	Mathematical modeling with chemica	Example studies regarding mathematical modeling with chemical master equation.
	3.	Reaction rate equation (basic)	Some basic knowledge about reaction rate equation (low of mass action, Michaelis-Menten equation, etc.)
	4.	Reaction rate equation (example stu	Example studies regarding reaction rate equation.
	5.	Transcriptional control (basic)	Some basic knowledge about transcriptional and translation control system.
	6.	Transcriptional control (example stu	Example studies regarding transcriptional and translation control system.
	7.	Dynamical systems analysis -equilib	Basic theories on equilibrium and stability.
	8.	Dynamical systems analysis -applica	Application examples of equilibrium and stability.
	9.	Dynamical systems analysis -lineariz	Basic technique of linearization of biological and molecular systems.
	10.	Dynamical systems analysis -lineariz	Example studies of linearization of biological and molecular systems.
	11.	Dynamical systems analysis -freque	Basic technique of frequency domain analysis of biological and molecular systems.
	12.	Dynamical systems analysis -robust	Basic technique of robustness analysis of biological and molecular systems.
	13.	Dynamical systems analysis -adapta	Basic knowledge of adaptation and disturbance rejection of biological
	14.	Dynamical systems analysis -oscillat	Basic knoledge of oscillation and bifurcation analysis of biological and molecular systems.
	15.	Dynamical systems analysis -singula	Basic knoledge of singular perturbation theory of biological and molecular systems.

General Course Policies(授業の進め方)		Lecture while writing on the white board
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students can understand basic methods/techniques/theories for analyzing biological and molecular systems.
	Couse objectives (具体的な授業の達成目標)	1. Basic understanding of mathematical modeling of biological and molecular systems. 2. Basic understanding of analysis techniques of biological and molecular systems. 3. Basic understanding of analysis theory of biological and molecular systems.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Report (No.1-5)
Assignment Instructions (授業外学習(予習・復習)の指示)		Students should prepare 4 hours preparatory study per a week.
Keywords(キーワード)		Systems biology, Molecular robotics, Control theory
Required Textbooks(教科書)		-
References/Recommended Reading(参考書)		-
Notes(備考)		-
Email(電子メールアドレス)		nakakuki@ces.kyutech.ac.jp

Course Name(科目名)	Advanced Information Physics		
Instructor Name(担当教員名)	Jong-Hoon Huh		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective and required course	Credits(単位数)	2
Course Description(授業の概要)	The liquid crystal phase appearing between the crystal and the liquid has various properties due to the anisotropy of the molecules. The liquid crystal display (LCD) has been remarkably developed in the past several decades and has become familiar to us. At present, research on liquid crystals can be broadly divided into physical properties and applied fields, and non-equilibrium dissipative pattern formation fields. In this lecture, we will start with the history of iscovering liquid crystals, and then lecture on the basic concepts and principles of various properties and applications of liquid crystals. In addition, the phenomenon of electroconvection, which became the starting point of application to the LCD, will be introduced from the viewpoint of pattern formations.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is intended for graduate students of the Graduate School of Information Engineering; we will apply electromagnetics, optics, and fluid dynamics to liquid crystals. In order to handle liquid crystals, which are anisotropic fluids, fundamental continuum and molecular theory is required. In addition, the basic background of physics such as ″electromagnetics″, ″viscoelastic mechanics″, ″optics″ and physical properties such as ″Landau's phase transition theory″ are required. Therefore, students who take this course must take basic courses in the following. ・“Basic physics and exercises” ・″Mechanics″ ・″Electromagnetics″ ・″Rheology″ ・″Information physics″		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Definition and classification of liquid crystals-1	
	2.	Definition and classification of liquid crystals-2	
	3.	Phase transitions-1	
	4.	Phase transitions-2	
	5.	Continuum theory of liquid crystals-1	
	6.	Continuum theory of liquid crystals-2	
	7.	Molecular theory of liquid crystals	
	8.	Electro-optical characteristics of liquid crystals-1	
	9.	Electro-optical characteristics of liquid crystals-2	
	10.	Electro-optical characteristics of liquid crystals-3	
	11.	Electrohydrodynamics-1	
	12.	Electrohydrodynamics-2	
	13.	Liquid crystal applications and recent liquid crystal devices	
	14.	Latest topics and research-1	
	15.	Latest topics and research-2	
General Course Policies(授業の進め方)		Electronically-made lecture notes (Power Point) will be mainly used. Commentary on recent papers will be given as necessary.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The aim is to be able to explain from the principle what the state of the liquid crystal phase is and how its anisotropy is applied (such as LCD). Furthermore, the goal is to be able to explain the concept and physical significance of the dissipative structure from the electroconvection phenomenon.	
	Couse objectives (具体的な授業の達成目標)	1. To explain from the principle what the state of the liquid crystal phase is and how its anisotropy is applied (such as LCD). 2. To explain the concept and physical significance of the dissipative structure from the electroconvection phenomenon. 3.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		At the end of the lecture, students will be required to give presentation-style assignments and reports.	
Assignment Instructions (授業外学習(予習・復習)の指示)		4 hours a week as a preparatory study	
Keywords(キーワード)		Liquid crystal properties and applications, electroconvection, nonequilibrium phenomena	
Required Textbooks(教科書)		None	
References/Recommended Reading(参考書)		・Physics of liquid crystals (Orihara, in Japanese) ・Electro-Optical and Magneto-Optical Properties of Liquid Crystals (Lev Mikhaylovich Blinov) ・The Physics of Liquid Crystals (P.G.de Gennes) ・LCD-Basics (co-edited by Koji Okano and Shunsuke Kobayashi, in japanese)	
Notes(備考)		None	
Email(電子メールアドレス)		huh@mse.kyutech.ac.jp	

Course Name(科目名)	Micro Fluics		
Instructor Name(担当教員名)	Katsuya Nagayama		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Knowledge of microfluidics is becoming essential in the expanding and expanding MEMS industry. Here, topics covering micro flow dynamics and various fields of application to MEMS are widely covered, and students will understand the basics and outline of micro fluid engineering. Specifically, it deals with microfluidics, flow inside micromachines, processing technology, and measurement technology such as microscopes. Divide a wide range of fields and conduct research and analysis in specific fields to deepen understanding.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Learning objectives of the Graduate School of Information Engineering (B) Learn the basic scholastic skills required in each field of information science and engineering from the viewpoint of micro-physical phenomena. Based on knowledge of basic physics and fluid dynamics in undergraduate education, develop into physics in micro systems. He is not limited to fluid mechanics, but deals with a wide range of micro-systems, such as micro-measurement and micro-machining, and gains much knowledge.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Microfluidics Overview	
2.	Molecular / nano thermal fluid	
3.	Micro thermal fluid	
4.	Interface and phase change	
5.	Micro channel	
6.	Electric field driven flow	
7.	Tribology	
8.	Nano materials	
9.	Measurement technology	
10.	Processing technology	
11.	MEMS packaging technology	
12.	Aapplication	Micro bubbles, micro thrusters
13.	Aapplication	Micro fuel cell, heat exchanger
14.	Aapplication	Nanotube, laser processing
15.	Aapplication	DNA, micro chemical system

General Course Policies(授業の進め方)		Share topics in microfluidics reference books and make presentations and discussions as appropriate. Add the latest technology findings to the contents of the reference book.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Learning objectives of the Graduate School of Information Engineering (B) To acquire basic academic skills required in information science and engineering and various fields from the viewpoint of micro-physical phenomena. Understand general physics including fluid dynamics in micro systems, and acquire the ability to apply to the field of micro devices.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Approximately 75% of the fields shared by the reference book were announced, including the latest technology, and approximately 25% were discussed in questions and answers.
Assignment Instructions (授業外学習(予習・復習)の指示)		Presentation materials should be prepared with the latest information. Review and examine any technical terms that you did not understand in class. As a preparatory study, prepare 4 hours a week.
Keywords(キーワード)		Micro flow, micro machine, micro machining, microscope
Required Textbooks(教科書)		Micro / Nano Thermal Fluid Handbook (NTS Publishing)
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		nagayama@mse.kyutech.ac.jp

Course Name(科目名)	Technical Japanese		
Instructor Name(担当教員名)	Jong-Hoon Huh		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	1
Course Description(授業の概要)	This course contains practical teaching and exercises for foreign students with intermediate-level Japanese or higher, in order to improve the technical Japanese ability in science and engineering; it helps to improve their ability to make experimental reports, research reports, and dissertations.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is planned with a series of Japanese / Japanese affairs courses("Japanese supplementary lectures", "Japanese A", "Japanese B", "Japanese C" and "Japanese affairs") for foreign students with intermediate or higher Japanese level. Accordingly, to students who take this course, the prerequisite courses is required. This course is offered jointly with undergraduate foreign students, and aims to improve practical academic Japanese such as experimental reports and dissertations.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Basic Technical Terms I	
	2.	Basic Technical Terms II	
	3.	Basic Expression I	
	4.	Basic Expression II	
	5.	Basic Expression III	
	6.	Reading the Science and Technology Columns I	
	7.	Reading the Science and Technology Columns II	
	8.	Intermediate test	
	9.	Science and Technology Text I-Introduction	
	10.	Science and Technology Sentence II-How to Write Experimental Methods / Results / Considerations	
	11.	Science and Technology Text III-Writing Conclusions	
	12.	Science and Technology Document IV-Points to Note	
	13.	Examples of experimental reports and dissertations	
	14.	Summary	
	15.	Semester-end test	

General Course Policies(授業の進め方)		Textbooks and reference materials are advanced through lectures and exercises.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In this lecture, foreign students will learn about the educational objectives of the Graduate School of Information Engineering (A) "Rich internationality, sociality, and ethics as an engineer" and (B) "Logical communication skills including English and Japanese." The goal is to be able to communicate science and technology in Japanese.
	Couse objectives (具体的な授業の達成目標)	1. To communicate sience and technology in Japanese 2. To express experimenatal results as reports and research papers in Japanese 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Two tests (medium and end of period) are conducted to measure the level of understanding of the lecture contents.
Assignment Instructions (授業外学習(予習・復習)の指示)		A preparatory study for 2 hours a week is recommended.
Keywords(キーワード)		None
Required Textbooks(教科書)		Handbook of Scientific and Technical Japanese (N. Yamazaki, Y. Tomita, Y. Hirabayashi, and Y. Hatano)
References/Recommended Reading(参考書)		Basic Technical Japanese (E. E. Daub, R. B. Bird, and N. Inoue)
Notes(備考)		None
Email(電子メールアドレス)		huh@mse.kyuech.ac.jp

Course Name(科目名)	Electromagnetics		
Instructor Name(担当教員名)	Kohno Haruhiko		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The lectures cover graduate-level topics on electromagnetic theory. Particular emphasis will be directed to the derivations of the basic equations with the use of several mathematical tools, such as Gauss's and Stokes's theorems.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	"Electromagnetics" is a course offered in Electronic Material Module. Students who take this course are expected to be familiar with electromagnetism at an undergraduate level and vector calculus.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Basics of electrostatics	
	2.	Differential form and boundary conditions	
	3.	Electrostatic capacity, method of images	
	4.	Separation of variables	
	5.	Dielectric material	
	6.	Basics of magnetostatics	
	7.	Magnetic material and electrostatic shield	
	8.	Low-frequency Maxwell's equations	
	9.	Circuits and current diffusion	
	10.	Motion of charged particles in static electric fields	
	11.	Motion of charged particles in static magnetic fields	
	12.	Full Maxwell's equations and displacement current	
	13.	Basics of electromagnetic waves	
	14.	Wave propagation in a homogeneous medium	
	15.	Demonstration of how to answer final exam questions	

General Course Policies(授業の進め方)	Lecture notes will be distributed in each class.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Acquire basic academic skills in the field of electromagnetics at a graduate level.
	Couse objectives (具体的な授業の達成目標)	1. Learn how to apply the basic equations for electromagnetic fields to various problems. 2. Understand the derivations of important equations and laws. 3. Learn about some important phenomena for industrial applications, such as electromagnetic shielding.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Homework 50%, Final exam 50%	
Assignment Instructions (授業外学習(予習・復習)の指示)	Get in at least four hours of preparation for each class.	
Keywords(キーワード)	Electromagnetic fields, Poisson's equation, Dielectric, Maxwell's equations, Motion of charged particles, Electromagnetic waves	
Required Textbooks(教科書)	Not required.	
References/Recommended Reading(参考書)	John David Jackson, "Classical Electrodynamics", Wiley (1998).	
Notes(備考)		
Email(電子メールアドレス)	kohno@mse.kyutech.ac.jp	

Course Name(科目名)	Advanced Lecture on Mechatrosystem		
Instructor Name(担当教員名)	Hiroyuki Narahara		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The new machinery based on 3D printer technology is produced increasingly one after another. A lecture is given about the Additive Manufacturing used as the basis of 3D printer technology. A lecture is given on the history, technology components, the state-of-the-art development trends, and future challenges. Furthermore, a miniaturization and advanced features are progressing in the latest mechanical system represented by the robot. A system configuration becoming complicated, extracting a useful parameter out of many parameters, and designing properly is required. The Quality Function Deployment (Quality Function Deployment:QFD) which attracts attention as an indispensable method from product development, quality engineering (Quality Engineering:QE), and HCD (human centered design) And a lecture is given about fundamental [of the KA process], and application. Here, a lecture and an exercise are conducted about the following four topics. 1. Summary and Hardware of 3D Printer 2. 3D Printer-related Software and Algorithm 3. Basic Knowledge on 3D Printer Material 4. Design, Product Development, and Research Process		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It aims at mainly supporting the basic knowledge of Additive manufacturing, and the research-and-development skill relevant to 3D printer research in this lesson. Since 3D printer is one of the electronic machine control systems represented by the robot etc., to an understanding of the component engineering, it is desirable to have mastered the knowledge of mechanical drawing, electronic circuit and programming.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	The history and the summary of 3D printer	
	2.	Hardware of 3D printer	
	3.	Basic knowledge on 3D printer material	
	4.	The application example of 3D printer	
	5.	3D printer-related software and an algorithm	
	6.	3D modeling and geometry data processing	
	7.	The geometry processing algorithm relevant to 3D printer	
	8.	3D printer related software	
	9.	Reprap firmware and a temperature control algorithm	
	10.	Reprap firmware and mechanism control algorism	
	11.	A design, product development, and a research process	
	12.	HCD (human centered design) and the KA process	
	13.	The way of thinking of a function, and the definition of a function	
	14.	An introduction to QFD (quality functional design)	
	15.	Quality engineering and a parameter design	
General Course Policies(授業の進め方)	It carries out in a seminar style.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In connection with a learning performance goal, the system evaluation technology toward a common item (B) and engineering developments of (1), (2), and (3) of a Major of Interdisciplinary Informatics and a Department of Mechanical Information Science and Technology, and a system construction is learned.	
	Couse objectives (具体的な授業の達成目標)	1. The summary and hardware of 3D printer are understood. 3D printer-related software and an algorithm are learned. 2. The basic knowledge on 3D printer material is understood. 3. He understands a design, product development, and a research process, and it can draw up a fundamental plan.	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Based on the middle report (20%) and the last report (80%) which are put within a lecture, evaluation is performed integrated.		
Assignment Instructions (授業外学習(予習・復習)の指示)	Perform preparation review, such as investigating and summarizing the contents of an exercise specified by lesson by the next time.		
Keywords(キーワード)	3D printer, Additive manufacturing, Robust Design, Quality Function Deployment, Quality Engineering		
Required Textbooks(教科書)	Hiromichi Onikura ed, "Kikai Seisaku Yoron", yokendo, 2016.		
References/Recommended Reading(参考書)			
Notes(備考)	It requires securing for 4 hours per week as preparation and review.		
Email(電子メールアドレス)	nara@mse.kyutech.ac.jp		

Course Name(科目名)	Advanced Tribology		
Instructor Name(担当教員名)	Kiyoshi HATAKENAKA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Tribology deals with lubrication, friction and wear. Since tribology deals with academic boundaries, it takes a lot of time to understand its contents unless one has basic knowledge in multiple fields, when one enters the industry and encounters tribology as a practical subject for the first time. In this course one will learn the basics of tribology and apply lubrication theory as an application to deeply understand sliding bearings.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	One is required to take all basic subjects in mechanical engineering.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Guidance	
	2.	Significance of tribology	
	3.	Contact with solid surface	
	4.	Friction	
	5.	Boundary lubrication	
	6.	Tribo test of wear	
	7.	Viscosity	
	8.	Lubricant	
	9.	Hydrodynamic lubrication theory	
	10.	Lubrication theory of plain bearings	
	11.	Numerical solution of pressure distribution in slider bearing	
	12.	Elasto-Hydrodynamic Lubrication	
	13.	Oral presentation of English article in Japanes	
	14.	Oral presentation of English article in Japanes	
	15.	Oral presentation of English article in Japanes	

General Course Policies(授業の進め方)		The first half of this course is a lecture style, and the second half is an oral presentation.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This course aims to acquire the goal of learning and education "(B) basic skills required in information science/engineering and various academic fields" in the Graduate School of Information Engineering, especially "(1) Development of advanced technologies in both machine and information fields" and "(2) Ability to realize design and production system based on knowledge of digital engineering, CAE, various dynamics simulations and advanced digital technologies" that are declared by the Department of Mechanical Information Engineering, Department of Information Systems. Specifically, one aims to achieve the following items.
	Couse objectives (具体的な授業の達成目標)	1. One understand the basics of tribology, apply the hydrodynamic lubrication theory as an application and analyze 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The specific goals listed above will be evaluated based on the content of oral presentation.
Assignment Instructions (授業外学習(予習・復習)の指示)		Two hours a week as a preparatory study
Keywords(キーワード)		Tribology, Friction, Wear, Lubrication, Surface, Contact, Viscosity, Lubricant, Boundary lubrication, Hydrodynamic lubrication theory, Sliding bearing, Elastohydrodynamic lubrication
Required Textbooks(教科書)		Masayoshi MURAKI, Tribology – Science of friction and lubrication technology –, Nikkan Kogyo Shimbun
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		hatakenaka.kiyoshi218@mail.kyutech.jp

Course Name(科目名)	Computational Mechanics		
Instructor Name(担当教員名)	Tomoyoshi HORIE		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Computational Mechanics approach such as finite element analysis is now widely applied to the mechanical design of various type of structures. To do the finite element analysis, it is important to learn about the basic theory of weighted residual method and variational principles that will lead to the formulation of the finite element method. The extension to the non-linear problem including elasto-plastic analysis and large deformation analysis is also presented in this lecture.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Studenta are requested to have passed "Computer Aided Engineering." Since the main topic of this course is the stress analysis, basic knowledge of elasticity, strength of material and numerical analysis are required.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	stress tensor	definition of stress in material
	2.	strain tensor	definition of strain
	3.	basic equations	formulation of principle of virtual work
	4.	total Lagrangean formulation	nonlinear formulation using TL approach
	5.	updated Lagrangean formulation	nonlinear formulation using UL approach
	6.	solid element	two-dimensional and three-dimensional isoparametric elements
	7.	shell element	element for thin structure
	8.	constitutive relation	material modeling
	9.	inelastic material behavior	elasto-plastic deformation
	10.	thermal conduction problem	equation of thermal conduction and its week form
	11.	time integration method	Newmark's beta method
	12.	solution of linear simultaneous equati	Cholesky factorization methods
	13.	solution of nonlinear equations	Newton-Raphson iteration method
	14.	nonlinear dynamics analysis	explicit and implicit integration
	15.	summary	

General Course Policies(授業の進め方)		Students have to make presentation in turn based on a textbook followed by the discussion on the above theme by all students.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The objective of this course is to understand the basic theory of the finite element method especially for the non-linear problem including elasto-plastic analysis and large deformation analysis.
	Couse objectives (具体的な授業の達成目標)	1. understand the basic concept of weighted residual method, variational priciples, and nonlinear analysis 2. be able to derive the formulation of nonlinear finite element method 3. be able to do the finite element non-linear structural analysis
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Presentation and attendance are mandatory. Evaluation is made through presentation (70%) and discussion (30%) in the class.
Assignment Instructions (授業外学習(予習・復習)の指示)		Preparation and review of the class for 4 hours per week are needed.
Keywords(キーワード)		finite element analysis, principle of virtual work, nonlinear analysis
Required Textbooks(教科書)		to be designated
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		horie@mse.kyutech.ac.jp

Course Name(科目名)	Intelligent Robot Control		
Instructor Name(担当教員名)	Hiroshi Ohtake		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Nowdays, the demand for robots has been growing rapidly in the fields of not only helping automation in factories, but also medical or nursing care, agriculture, entertainment, disaster rescue, and so on. In this lecture, robot control methods will be explained from basic knowledge to applied techniques. In addition, our understanding will be deepened by investigating and considering the latest robots and their control methods.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	In order to take this course, basic knowledge of mathematics, mechanics, and control engineering is required. Therefore, it is assumed that the following subjects have been completed. "Linear Algebra" "Physics" "Differential Equation" "Dynamics" "Control Engineering"		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Vector and matrix	review of linear algebra
2.	Linear Control I	learn modern control theory (state equation, stability)
3.	Linear Control II	learn modern control theory (controller design, observer design)
4.	Sensors	introduce sensors for robot
5.	Actuators	introduce actuators for robot
6.	Robot Control I	learn robot control (kinematics, inverse kinematics)
7.	Robot Control II	learn robot control (dynamics, inverse dynamics)
8.	Intelligent Control (Rule-based Fuzzy Control I)	learn fuzzy control (fuzzy sets, fuzzy inference)
9.	Intelligent Control (Rule-based Fuzzy Control II)	learn fuzzy control (fuzzy control)
10.	Nonlinear Control I (Model-based Fuzzy Control I)	learn model-based fuzzy control (fuzzy model construction)
11.	Nonlinear Control I (Model-based Fuzzy Control II)	learn model-based fuzzy control (fuzzy controller design)
12.	Introduction to various Robot Contro	introduce to flying robots and wheel chair control
13.	Survey, Consideration, Presentation	presentation on robot, control, intelligent control, and so on.
14.	Survey, Consideration, Presentation	presentation on robot, control, intelligent control, and so on.
15.	Survey, Considering, Presentation III	presentation on robot, control, intelligent control, and so on.

General Course Policies(授業の進め方)		This lecture is held in in a didactic manner (lecture style). Students create reports on the contents of the
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal is to learn basic robot control methods based on control theory, and to be able to understand the latest robots and their control methods.
	Couse objectives (具体的な授業の達成目標)	1. Understand how to design control systems based on linear control theory 2. Understand the measurement and drive principles of various sensors and actuators used in robots 3 Understand the control method of multi-link robot 4 Understand how to design control systems using fuzzy control techniques
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Give a few report tasks within the scopes of the lecture. And evaluate the achievement of the goals using the reports (50%). Furthermore, evaluate the presentation (20%) and the final report (30%) on robot control.
Assignment Instructions (授業外学習(予習・復習)の指示)		Please keep 4 hours a week for a preparatory study. Listen carefully and take notes. Check literatures on robot control on a routine basis for final presentation.
Keywords(キーワード)		Robot control, linear control, nonlinear control, fuzzy control, mechatronics, robotics
Required Textbooks(教科書)		Necessary materials will be provided as needed.
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		hohtake@mse.kyutech.ac.jp

Course Name(科目名)	Applied Kinematics		
Instructor Name(担当教員名)	Akihiro Hayashi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course introduces the mathematical methods to be required for applying robotic technologies into a practical stage of industiral field, human life support, and so on.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This covers the mathematical models to describe robotic kinematis. The essencial of methematics which had already learned by the courses such as linear algebra and analysis to be opened in the first annual experience.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	Outline of Robotic Kinematics	
2.	Frame Rotation in a Plane	
3.	Frame Rotation in a Space	
4.	Homogeneous Coordination and Hom	
5.	Quaternion Algebra and Geometry	
6.	Definition of Forward Kinematics	
7.	Danavit-Hartenberg Method	
8.	Solution Method of Inverse Kinematic	
9.	Algebratic and Geometric Method	
10.	Numerical Solution of Inverse Kinema	
11.	Differential Calculus Kinematics	
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		The basic of above topics are lectured .
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	At the end of course, students are expected to explain the essential concepts of robotic kinematics, to discess methematical model of robotic kinematics, and to apply mathematical model into practical robotic problem.
	Couse objectives (具体的な授業の達成目標)	1. to be able to fomulate the various types of rotation matrix. 2. to be able to describe the motion of mechanical systems and methematical model of forward kinematics. 3. to be able to understand the variation of soluton methods in robotic Invers Kinematics.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Class attendance and attitude in class 50% and short erports 50%.
Assignment Instructions (授業外学習(予習・復習)の指示)		It is highly recommended to about 2 hours prepare each lecture by reading the documents uploaded for e-learning site. This course will be more or less demanding depending on the initial level in mathematics. It is also recommended to study in detail examples of a available textbook of linear algebra and analysis..
Keywords(キーワード)		
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		hayashi@mse.kyutech.ac.jp

Class Name(科目名)	Applied Optics in Nanoscale Measurement			
Instructor Name(担当教員名)	Panart Khajornrungruang			
Course intended for(対象学年)	1st or 2nd year student			
Credit Category(単位区分)	Elective course		Credits(単位数)	2
Course Description(授業の概要)	Nanoscale phenomenon observation is indispensable to innovate the development in precision fields such as semiconductor manufacturing, medicine and green energy. In this classwork will focus on the application of light, which is one of the importances to explore the possibility of a novel advanced dynamically measurement method in these nanoscale phenomena.			
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This classwork is in Precision Engineering Module, Applied Optics Module and also Advanced in Mechanical Information Science and Technology Module.			
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)	
	1.	Prolog		
	2.	Fundamental in Optics and Metrology	Precision measurement I	
	3.		Precision measurement II	
	4.		Geemotrical optics I	
	5.		Geemotrical optics II	
	6.		Geometrical optics III	
	7.		Wave optics I	
	8.	Optical Diffraction limit and uncertainty in nanoscale	Wave optics II	
	9.		Wave optics III	
	10.		Quantum optics	
	11.		Superresolution I	
	12.		Superresolution II	
	13.	Possibility in applied optics in nanoscale metrology and manufacturing	Optical observation in Semiconductor and medicine	
	14.		Optical measurement in chemistry	
	15.	Epilog		
General Course Policies(授業の進め方)	Each participant will present one by one as in seminar style and commentary will be appropiately given in a			
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Understand the limit and the way to reduce uncertainty in optical precision method.		
	Couse objectives (具体的な授業の達成目標)	1. Understand the fundamental of optics (Geometric, Wave, Quantum in Optics) 2. Undestand the reason of optical uncertainty and optical diffraction limit and the way to reduce. 3. Be able to establishment the optical method for measurement and evaluation in research &		
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)	Based on discussions and presentations in classwork.			
Assignment Instructions (授業外学習(予習・復習)の指示)	Preparation and understanding in advance, particularly in the part that will be presented.			
Keywords(キーワード)	Applied Optics, Laser, Nanoscale, Metrology, Measurement			
Required Textbooks(教科書)	・Eugene Hecth: Optics, 5th edition, Pearson (2016) ・Eugene Hecht(著)、尾崎義治・朝倉利光(訳):原著5版 ヘクト 光学 I, II, III、丸善出版 など			
References/Recommended Reading(参考書)	・Eugene Hecth: Optics, 5th edition, Pearson (2016) ・Eugene Hecht(著)、尾崎義治・朝倉利光(訳):原著5版 ヘクト 光学 I, II, III、丸善出版 ・Max Born, et. al.: Principle of Optics, Cambridge Univ. Press ・Max Born ほか(著):草川徹(訳):光学の原理 I, II, III、東海大学出版 ・Francis A. Jenkins: Fundamental of Optics, McGraw Hill など			
Notes(備考)	n.a.			
Email(電子メールアドレス)	panart@mse.kyutech.ac.jp			

Course Name(科目名)	Advanced Machining Technology		
Instructor Name(担当教員名)	Koresawa Hiroshi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In the production process of modern industrial products, it is essential to use computer-aided design and production system support. This system is realized using various modeling techniques on computer. First, this lecture shows concept of geometry processing and mathematical expression of curved lines and surfaces. Next, tool path generation algorithm and machining with numerical control is described. Last, overview of injection molding and its simulation method on molding process is explained.☐		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture develops basic skills required in information science / engineering fields.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Outline of the lecture	Introduction to manufacturing processes and manufacturing systems including assembly, machining, injection molding, casting, thermoforming, and more.
	2.	Processing for curved line and surface	Mathematical definition and its caluclations.
	3.	Basis of machining with numerical control	Generation of tool path tequniqes and machining by the path on numerical contorl
	4.	Outline of injection molding and mold	Basic concept for injection molding and mold
	5.	Simulation of injection molding for its process	Injection molding process by ussing computer and its simulation methods
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General Course Policies(授業の進め方)		This lecture helds in a seminar format.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Understanding of modeling methods and mathematical expression on computer
	Couse objectives (具体的な授業の達成目標)	1. Given a definition and calculation for curved line and surface on computer 2. Given a programming for tool path generation 3. Given an evaluation of results of numerical analysis on injection process
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Paper pencil assignments: 50% Class exams: 50%
Assignment Instructions (授業外学習(予習・復習)の指示)		4 hours of preparation and homework assignments a lecture
Keywords(キーワード)		Injection molding, Mold, Simulation of formation, Generation method for tool path
Required Textbooks(教科書)		No textbook
References/Recommended Reading(参考書)		David O. Kazmer, Injection Mold Design Engineering, Hanser Pub Inc, (2016)
Notes(備考)		None
Email(電子メールアドレス)		koresawa@mse.kyutech.ac.jp

Course Name（科目名）	Advanced Energy Principles and Finite Element Methods		
Instructor Name(担当教員名）	Niho, Tomoya		
Course intended for（対象学年）	1st or 2nd year student		
Credit Category（単位区分）	Elective course	Credits（単位数）	2
Course Description（授業の概要）	Finite element analysis method are widely used in design and development of mechanical structure. This course provides the energy principles and the principles of virtual works that required to understand the fundamental principles for the finite element analysis methods. Further, the approximate methods and the finite element methods are also provide		
Course and Curriculum linkage （カリキュラムにおけるこの授業の位置付け）	The aim of this course to help students acquire an understanding of the fundamental principles of the finite element methods. It is desirable to take the courses “Computer Aided Engineering” and “Computational Mechanics” in the master’s course.		

Course Calendar/Class Topic（授業計画）		Theme(テーマ）	Contents（内容）
	1.	Displacement theory of elasticity	
	2.	Stress energy and complementary energy	
	3.	Variational principle	Principle of virtual work
	4.	Variational principle	Principle of minimum potential energy
	5.	Variational principle	Principle of complementary virtual work
	6.	Variational principle	Principle of minimum complementary potential energy
	7.	Approximate method based on variational princip	Principle of virtual work
	8.	Approximate method based on variational princip	Principle of minimum potential energy
	9.	Approximate method based on variational princip	Principle of complementary virtual work
	10.	Approximate method based on variational princip	Principle of minimum complementary potential energy
	11.	Displacement method and force method	
	12.	Finite element analysis method	Principle of virtual work
	13.	Finite element analysis method	Principle of minimum potential energy
	14.		
	15.		

General Course Policies（授業の進め方）	The above items of textbook are introduced by the presenter, and discussed by all students.	
Course Objectives（授業の達成目標）	Introduction to Couse Objectives（授業の達成目標の解説）	The aim of this course is to help student acquire an understanding of the fundamental principles and a formulating of the finite element analysis method. The goals of this course are to
	Couse objectives（具体的な授業の達成目標）	1. Understand the virtual work principle, the approximation methods and the finite element methods based on this principle 2. Understand the principle of minimal potential energy, the approximation methods and the finite element methods based on this principle 3. Understand the complementary virtual work principle and the approximation methods based on this principle 4. Understand the principle of minimum complementary potential energy and the approximation methods based on this principle
Evaluation Methods and Grading Criteria（成績評価の基準および評価方法）	Grade will be decide based on attendance, understanding, reports, presentation and discussion.	
Assignment Instructions（授業外学習（予習・復習）の指示）	Presenter understand your presentation part in the textbook, and prepare presentation material. All student perform the exercises, and prepare to explain its answer to all students. 4 hours preparation are required before every classes.	
Keywords（キーワード）	Variational principle, stationary condition, Gauss’s divergence theorem, Lagrange multiplier, Conditions of compatibility, Stress-strain relationship	
Required Textbooks（教科書）	鷲津久一郎, エネルギ原理入門（有限要素法の基礎と応用シリーズ3）, 培風館	
References/Recommended Reading（参考書）		
Notes（備考）	This course will be taught in Japanese.	
Email（電子メールアドレス）	niho@mse.kyutech.ac.jp	

Course Name(科目名)	Micro Devices/Microsystems		
Instructor Name(担当教員名)	Sunao MURAKAMI		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course introduces the fundamentals of the microdevices and microsystems including MEMS, which contain mechanical and electrical micro-elements as the functional units of them. In particular, the fundamentals of the design and the microfabrication techniques are introduced, and some practical examples and topics of MEMS are also explained.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	In terms of the course and curriculum linkage in the learnig education goal of Graduate School of Computer Science and Systems Engineering, this course is positioned as part of lectures to obtain the basic academic skills which are required in various areas including informartion science and engineering.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Overview of microdevices and microsystems	
	2.	Materials used for Microdevices (1)	
	3.	Materials used for Microdevices (2)	
	4.	Microfabrication processes (1)	
	5.	Microfabrication processes (2)	
	6.	Micromachinig technique for MEMS	
	7.	Fundamentals of operation principle and design of MEMS	
	8.	topics on MEMS devices	
	9.	Physical microsensors (1)	
	10.	Physical microsensors (2)	
	11.	Micro actuators	
	12.	Micro chemical systems	
	13.	Summury	
	14.		
	15.		
General Course Policies(授業の進め方)	This course will be taught with explainations (PPTs) and handouts for the lecture.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Main aims of this course are review and deepen knowledge and understanding of the fundamentals of microdevice, microsystems including MEMS.	
	Couse objectives (具体的な授業の達成目標)	1. Students are expected to explain the summary of microdevices, microsystems and MEMS	
		2. Students are expected to obtain the basic knowledge about the microfabrication techniques	
		3. Students are expected to explain the technology relating to microdevices and microsystems with some	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Final grade will be decided based on some homeworks (short reports) relating to the selected topics of the lecture (40%), and a final report (60%).		
Assignment Instructions (授業外学習(予習・復習)の指示)	Student are required 4-hours preparations for the topics of the class before each class.		
Keywords(キーワード)	Microdevices, Microsystems, Microelectromechanical systems (MEMS), Microfabrication, Micromaching		
Required Textbooks(教科書)	Text books are not used. Refferences are introduced in the class. Some materials are provided in each class.		
References/Recommended Reading(参考書)	Some references are introduced in the class.		
Notes(備考)	Basically, this course will be taught in Japanese.		
Email(電子メールアドレス)	murakami[at]mse.kyutech.ac.jp (Please change "[at]" to "@" in the mail address written in the left.)		

Course Name(科目名)	Introduction to Entrepreneurship		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	1
Course Description(授業の概要)	Students learn a mindset and knowledge required for entrepreneurs and startup. They also learn a broad range of basic knowledge including management, sales, finance, marketing, funding, and intellectual property to make a business plan.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Students learn entrepreneurships so that they can become leaders responsible for global innovation.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Entrepreneurship and startup	
2.	Search, identification and evaluation	
3.	Business model and strategy	
4.	Survival strategy	
5.	Sales and marketing	
6.	Accounting and finance	
7.	Organizational structure and funding	
8.	Final examination	
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15.		

General Course Policies(授業の進め方)		Lecture
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn a broad range of basic knowledge required for an entrepreneur and startup.
	Couse objectives (具体的な授業の達成目標)	1. To learn a mindset of entrepreneurs 2. To learn basic knowledge required for startup. 3. To learn basic knowledge to make a business plan
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Presentation
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		entrepreneurship, startup, business, management, pitch, venture capital
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Entrepreneurship with Exercise		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	1
Course Description(授業の概要)	Students learn a mindset, knowledge and skills required for entrepreneurs and startup. They also learn a broad range of basic knowledge and skills including management, sales, finance, marketing, funding, and intellectual property to make a business plan.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Students learn entrepreneurships so that they can become leaders responsible for global innovation.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Pitch presentation	
	2.	Market sizing	
	3.	Business plan	
	4.	Differentiation strategy	
	5.	Scale strategy	
	6.	Tips for documentation	
	7.	Tips of presentation	
	8.	Final examination	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lecture with exercise
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn a broad range of basic knowledge and skills required for entrepreneurs and startup.
	Couse objectives (具体的な授業の達成目標)	1. To learn a mindset of entrepreneurs 2. To learn basic knowledge and skills to make a business plan 3. To learn basic knowledge and skills required for startup.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		entrepreneurship, startup, business, management, pitch, presentation, venture capital
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Computation Methods for Molecules		
Instructor Name(担当教員名)	Matsuyama Akihiko		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Soft matter, such as polymers, liquid crystals, surfactant molecules, and gels, is important in the fields of food, medicine and material science. It is also the substance that makes up our bodies, and as a result of various interactions, the most complex phenomena of life occur.. In this lecture, we will learn statistical mechanical theory and computer simulation methods for phase separation and phase transition in soft matte, mainly, Polymer and Liquid Crystals.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture belongs to the Biological Structure Module and teaches the physical basis of the soft matter that make up living organisms. Understanding the physical properties of soft matter requires understanding of a wide range of physics, chemistry, and biology. In this lecture, we will learn how soft matter is treated by statistical mechanics and computer simulation.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Soft Matter	(1) Introduction of soft matter
	2.	Statistical physics of single polymer chain	(2)-(3) Statistical physics of Single polymer chain
	3.	Ideal chain	
	4.	Theory of polymer solutions	(4)-(7) Physics of Polymer solutions and polymer blends
	5.	Phase separatiuons of polymer solutions	phase separations and dynamics
	6.	Spinodal decomppositions	
	7.	Nucleation and growth	
	8.	Physics of Liquid Crystals	(8)-(14) Physica of liquid crystals
	9.	Order parameters	
	10.	Theory of Liquid Crystalline solutions	
	11.	Onsager theory	
	12.	Nematic-isotropic phase transitions	
	13.	Maier-Saupe theory	
	14.	Smectic liquid crystals	
	15.	Recent topics of soft matter	(15) Current topics in soft matter

General Course Policies(授業の進め方)	Lecture	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The objectives is to learn the basics of soft matter substances, which are expected to be applied to a wide range of fields such as life sciences and nanomaterials.
	Couse objectives (具体的な授業の達成目標)	1. Polymer 2. Liquid Crystal 3. Soft Matter
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Report	
Assignment Instructions (授業外学習(予習・復習)の指示)	As a preparatory study, prepare 2 hours a week.	
Keywords(キーワード)	polymer, liquid crystal, soft matter	
Required Textbooks(教科書)	Original text will be prvided.	
References/Recommended Reading(参考書)	search Soft Matter Physics	
Notes(備考)	See Moodle for more informations	
Email(電子メールアドレス)		

Course Name(科目名)	Biosimulation		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Students learn knowledge and skills required for scientists and engineers in the field of systems biology and computational biology. Students learn a biochemical network map construction, mathematical modeling of biochemical reactions, and system analysis to rationally design biochemical networks for an engineering or biomedical purpose		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Biosimulation requires knowledge and skills of differential equations, linear algebraic equations, and numerical analysis.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Importance of systems biology	
	2.	Biochemical network map constructi	
	3.	Mathematical modeling of biochemical networks	
	4.	Enzyme reaction	
	5.	Complex enzyme reaction	
	6.	Modeling of large-scale metabolic networks	
	7.	Robustness and control	
	8.	Steady-state analysis	
	9.	Sensitivity analysis	
	10.	Stability analysis	
	11.	Transcription-translation model	
	12.	Gene regulatory model	
	13.	Metabolic flux analysis	
	14.	Flux balance analysis	
	15.	Final examination	

General Course Policies(授業の進め方)		Lecture
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn knowledge and skills of scientists and engineers in the field of systems biology and computational biology.
	Couse objectives (具体的な授業の達成目標)	1. To learn a dynamic modeling of large-scale biochemical networks 2. To learn mathematical methods to analyze the dynamic models. 3. To rationally design biochemical network for an engineering or biomedical purpose
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Final examination
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		genome, biochemical network, metabolism, enzyme reaction, gene expression, differential equation, algebraic equation, robustness, feedback control
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Bioinformatics and Biochemical Systems Engineering		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Students learn the knowledge and skills of scientists and engineers in the field of computational systems biology and synthetic biology. Students learn the structure and functions of elementary biochemical networks and acquire engineering methods to rationally design biochemical networks for an engineering or biomedical purpose.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Course 'Biosimulation' or 'Systems Biology' is needed.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Importance of systems and synthetic biology	
	2.	Transcriptional network motifs	
	3.	Autoregulation	
	4.	Bistability	
	5.	Single input module	
	6.	Feedforward loop I	
	7.	Feedforward loop II	
	8.	Combined networks	
	9.	Design of combined networks	
	10.	Temporal program of gene expression	
	11.	Memory function	
	12.	Oscillatory systems	
	13.	Signal transduction for decision makin	
	14.	Protein circuits for perfect adaptation	
	15.	Final examination	

General Course Policies(授業の進め方)		Lecture
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn the strategy and methods to rationally design biochemical networks for an engineering or biomedical purpose.
	Couse objectives (具体的な授業の達成目標)	1. To understand the structure and functions of elementary networks or network motifs. 2. To understand how elementary networks are combined to make complex functions. 3. To learn the method to rationally design biochemical networks.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Final presentation or examination
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		elementary network, combined network, structure, function, rational design, computer-aided design, robustness
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Advanced Bioinformatics		
Instructor Name(担当教員名)	YADA Tetsushi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Bioinformatics is an interdisciplinary field that understand biological phenomena from viewpoints of information science. In this course, we read a state-of-art paper concerning with bioinformatics.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is desirable to complete an undergraduate subject 'bioinformatics'.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
2.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
3.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
4.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
5.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
6.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
7.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
8.	Colloquium	Reading a state-of-art paper concerning with bioinformatics.
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General Course Policies(授業の進め方)		Mainly colloquium style, partially lecture style.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The main objective of this course is to get an idea to solve various biological issues by using bioinformatics approaches.
	Couse objectives (具体的な授業の達成目標)	1. Understanding bioinformatics methods for biological data analysis. 2. Understanding recent advances in (molecular) biology brought by bioinfomatics researches. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluated by oral presentation in colloquium.
Assignment Instructions (授業外学習(予習・復習)の指示)		Read the paper carefully in advance. 4 hrs per week for preparation.
Keywords(キーワード)		Bioinformatics, Genome, Gene, RNA, Protein, Evolution
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		ytetsu@bio.kyutech.ac.jp

Course Name(科目名)	Computational and Integrative Biology		
Instructor Name(担当教員名)	Kazuhiro Takemoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course introduces "Network Science." Network science is a research area in which complex networks are studied, and it originates from graph theory. Networks describe the relationships among elements, and are, thus, simple and powerful tools for describing complicated systems. The concept of networks is universal and can be applied to a wide range of fields (e.g., mathematics, computer science, economy, sociology, chemistry, biology). This course focuses on the fundamental concepts and applications of network science (especially, in biology). The topic are as follows.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is based on discrete math, linear algebra, statistics, numerical computation, artificial intelligence, and bioinformatics.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	What is network science
	2.	Graph theory	Revisiting graph theory
	3.	Network representation	Network properties and measures
	4.	Centrality analysis	Finding important nodes from complex networks
	5.	Random networks	Random network models as null models
	6.	Small-world networks	The fundamental concepts and applications
	7.	Network motifs	Finding important subgraphs from complex networks
	8.	Generative models for complex netw	Extended random networks, evolving networks, and more
	9.	Stochastic block models	Application to network clustering
	10.	Community detection	Detecting communities (groups) from complex networks
	11.	Network robustness	Measuring network robustness and finding critical nodes
	12.	Network controllability (1)	Maximum matching-based approach
	13.	Network controllability (2)	Minimum dominating set-based approach
	14.	Random matrix theory	The fundamental concepts and applications
	15.	Correlation networks	Estimating networks from high dimensional data
General Course Policies(授業の進め方)	This course is lecture-style, but practice-style partly.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The goal is to acquire the fundamental concepts and applications of network science. The specific objectives are as follows.	
	Couse objectives (具体的な授業の達成目標)	1. To aquire the fundamental concepts of network science (theories, models, methods, etc.) 2. To design real-world application of network analysis 3. To perform network analysis using scripting languages (e.g., R and Python)	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	The evaluation is based on reports and homeworks.		
Assignment Instructions (授業外学習(予習・復習)の指示)	Use the online course materials for preparation and review. At least 4 hours per week is required for preparation.		
Keywords(キーワード)	networks, graphs, discrete algorithm, bioinformatics, network analysis		
Required Textbooks(教科書)			
References/Recommended Reading(参考書)	「Network Science」http://barabasi.com/networksciencebook/ 「Lectures on Complex Networks」 https://sites.google.com/site/sergeydorogovtsev/lectures_on_complex_networks 「Tutorial on R+igraph」https://sites.google.com/site/kztakemoto/resources		
Notes(備考)			
Email(電子メールアドレス)	takemoto@bio.kyutech.ac.jp		

Course Name(科目名)	Pharmacoinformatics		
Instructor Name(担当教員名)	Yoshihiro Yamanishi		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Information technologies for healthcare and drug discovery based on various big data are explained in the lecture. In particular, statistical machine learning methods (base technology for AI) based on large-scale omics data such as genomes, transcriptomes, proteomes, and metabolomes are discussed discussed.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belogs to the life system informatics module. This is based on mathematics, informatics, chemistory, biology-related courses in the department.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Basics on pharmacoinformatics	
	2.	Bioinformatics (1)	
	3.	Bioinformatics (2)	
	4.	Bioinformatics (3)	
	5.	Chemoinformatics (1)	
	6.	Chemoinformatics (2)	
	7.	Chemoinformatics (3)	
	8.	Medicalinformatics (1)	
	9.	Medicalinformatics (2)	
	10.	Medicalinformatics (3)	
	11.	Drug discovery informatics (1)	
	12.	Drug discovery informatics (2)	
	13.	Drug discovery informatics (3)	
	14.	Drug discovery informatics (4)	
	15.	Drug discovery informatics (5)	

General Course Policies(授業の進め方)	This course is based on the lecture and exersise. Students have some opportunities for presentations.	
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students understand the contents on pharamcoinformatics.
	Couse objectives (具体的な授業の達成目標)	1. Students understand big data analysis in life science and drug discovery. 2. Students understand medical applications of statistical machine learning. 3. Students understand pharmaceutical applications of statistical machine learning.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Attendance, reports, and exersises are totally evaluated.	
Assignment Instructions (授業外学習(予習・復習)の指示)	Students have to keep around four hours per week for preparation and pre-learning.	
Keywords(キーワード)	Drug discovery, healthcare, bioinformatics, chemoinformatics, statistics, machine learning	
Required Textbooks(教科書)	No need	
References/Recommended Reading(参考書)	Necessary materials are given in the lecure.	
Notes(備考)		
Email(電子メールアドレス)	yamani@bio.kyutech.ac.jp	

Course Name(科目名)	Biomolecular Information		
Instructor Name(担当教員名)	Junshi Sakamoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Biomembranes and membrane proteins play important roles in all living organisms. This lecture describes physiological functions and molecular structures of ion pumps, ion channels, drug receptors, solute transporters and respiratory enzymes.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture expect students to have undergrad-level knowledge of biochemistry, biophysics, and molecular biology.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	biomembranes and membrane protein	two lectures
2.	how to handle membrane proteins	two lectures
3.	drug receptors	two lectures
4.	ion channels	two lectures
5.	signal transduction on biomembranes	two lectures
6.	ion pumps and transporters	two lectures
7.	energy drancduction and chemiosmos	three lectures
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General Course Policies(授業の進め方)		lectures and casual oral exams
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	achieve aims (D), (1) and (3)
	Couse objectives (具体的な授業の達成目標)	1. basic knowledge on funcitons and structures of membrane proteins 2. understand physiological importance of biomembranes 3. quantitative understanding of the membrane potential and the ion motive force
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		oral exams at every class
Assignment Instructions (授業外学習(予習・復習)の指示)		two hour review after every class
Keywords(キーワード)		fluid mosaic model, neurotransmitter, protein stereostructure, geneme, electrochemical potential
Required Textbooks(教科書)		hand made (free)
References/Recommended Reading(参考書)		Biology, for Physical Sciences and Engineerings (Shokabo, ISBN978-4-7853-5231-8)
Notes(備考)		
Email(電子メールアドレス)		sakamoto@bio.kyutech.ac.jp

Course Name(科目名)	Cell Signal Transduction		
Instructor Name(担当教員名)	Shunsuke Aoki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Lectures are for learning the latest research results on cell signaling. The teaching materials on academic papers published in the academic journal "Cell" are used to understand cutting-edge cell biology and to develop research design skills.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	In order to grasp the whole cell or life as a system, it is necessary to understand the main subsystems, gene expression system, cell signaling system and energy metabolism system.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	RTK signaling pathway	
	2.	ras-grab signaling molecules	
	3.	p53 and Rb molecules	
	4.	UPS system	
	5.	ubiquitination and cell signals	
	6.	E1-E2-E3 pathway	
	7.	deubiquitination systems	
	8.	anti-cancer drugs	
	9.	Presentation and discussion 1	
	10.	Presentation and discussion 2	
	11.	Presentation and discussion 3	
	12.	Presentation and discussion 4	
	13.	Presentation and discussion 5	
	14.	Presentation and discussion 6	
	15.	Presentation and discussion 7	

General Course Policies(授業の進め方)		Lectures are conducted mainly on reading, presenting, asking questions, and group discussions on English
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to grasp the whole cell or life as a system, it is necessary to steadily understand the main subsystems. Therefore, we will concentrate on the characteristics of genetic information expression system, cell signal transmission system, energy metabolism system, and experimental and theoretical analysis methods.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The evaluation is based on the content of the presentation and reports.
Assignment Instructions (授業外学習(予習・復習)の指示)		You have to prepare your presentations. In addition, you have to submit reports, etc. 4 hours a week as a preparatory study.
Keywords(キーワード)		Cell, information transmission, English academic papers, biotechnology, bioinformatics, molecular biology, cell biology
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Computational molecular biophysics		
Instructor Name(担当教員名)	Masayuki Irisa		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Shannon entropy in information theory and Gibbs entropy in non-equilibrium state have the identical equation. Relation between a measure of information, entropy, and functions of biomolecules is reviewed based on statistical mechanics. For example, protein has an unique conformation, tertiary structure, in water. A principle of determination of a native conformation from amino-acid sequence, primary structure is explained. Furthermore, static and dynamic characters of a native conformation of protein, molecular motors, and roles of cations and water in DNA cleavage by restriction enzymes are explained based on recent theoretical and computer simulation studies. Mainly, theories of protein in aqueous solution based on statistical mechanics, especially theory of molecular liquids.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is addressed in the module of "Information of Biological Structure". Characters of biomolecules, protein and DNA, are explained in biophysical aspects through computational chemical physics. Basic knowledge of biology is required. Biomolecules have functions in aqueous solution. Knowledge of thermodynamics, statistical mechanics, and quantum mechanics are also required. This course has relationship with not only biological courses but also computer science courses through statistical mechanics, e.g. optimization problem, graph theory, computational geometry, information entropy, boundary element method, and finite element method. To take this course, it is prerequisite to take courses, Modern Physics, Basic Physics, Chemical Thermodynamics, Biomolecule, and Bioinformatics.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction: Thermodynamics and statistical mechanics	Relation between thermodynamic equations and statistical mechanics
2.	Shannon entropy and thermodynamic entropy	Identical equation for Shannon entropy and Gibbs entropy in non-equilibrium state
3.	Derivation of micro-canonical, canonical, grand-canonical, and T-P-mu ensembles	Derivation of the four ensembles by maximizing Gibb entropies with ensemble-dependent conditions
4.	Feynman ratchet model for molecular motors	Principles of molecular motors in non-equilibrium state – an example of actin-related molecular motor system explained with Feynman ratchet model
5.	Theory of molecular liquids and computer simulation	Formulas of calculating solvation free energies by using molecular dynamics
6.	Theory of non-ideal liquid	Cluster expansion in grand-canonical ensemble
7.	Statistical theory of hard-spheres: Scaled particle theory, van der Waals EOS, cluster expansion of grand potential	Virial coefficients, activities, osmotic pressure, head capacity, and partial molar volume.
8.	Protein thermodynamics and molecular dynamics	Thermodynamic quantity calculation of protein by using molecular dynamics
9.	Primary, secondary, tertiary, and quaternary structures of protein	Experiments showing differences between protein and polymer
10.	Review of studies on protein by using molecular dynamics and Monte Carlo method – present studies	Protein structure and hydration of protein
11.	Hydration of protein and microscopic surface tension	statistical mechanics method incorporating effects from non-spherical shape of protein
12.	Macromolecular crowding effect and scaled particle theory	interpretation of volume entropy in polymer science with statistical mechanics of molecular liquids
13.	Review of studies on mechanics of molecular motors	present studies
14.	Integral equation method in statistical mechanics of molecular liquids	Ornstein-Zernike integral equation and Debye-Huckel theory of elect
15.	1D-RISM and 3D-RISM theory	Application on Mg2+ and water molecule distribution in active sites of EcoRV-DNA complex

General Course Policies(授業の進め方)		Oral presentation including computer graphics presentation
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to achieve an aim of a super course, Bioinformatics Course, "to learn methodologies of computer science, system technology, and biophysics to understand biological systems at the molecular level from diverse biological information," the objective of this course is "to learn basic knowledge of biophysics and computational chemical physics of biomolecules in aqueous solution." The objective is included in the objective of the Graduate School of Computer Science and Systems Engineering, (B), "basic knowledge of computer science and technology, and other subjects."
	Couse objectives (具体的な授業の達成目標)	1. To understand thermodynamics based on statistical mechanics 2. To understand the relation between theory of molecular liquids and computer simulation 3. To understand protein with statistical-mechanics and computer-simulation
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		There will be homework each week (40%) and final report (60%).
Assignment Instructions (授業外学習(予習・復習)の指示)		4 hours are required for home-work
Keywords(キーワード)		statistical mechanics, thermodynamics, computer simulation, molecular dynamics, theory of molecular liquids, protein, water, entropy, information entropy, biophysics, single molecule measurement
Required Textbooks(教科書)		・ Yasushi Takahashi, Toukeirikigaku-Nyumon (Koudansha) ・ L.E.Reichl, Modern Course in Statistical Physics (Univ of Texas Pr) ・ Kiyoshi Arakawa, Mizu・Suiyoueki no Kouzou to Bussei (Univ. of Hokkaido) ・ Katsuhide Yutani and Haruki Nakamura: Tanpakushitsu Kougaku (Asakura Shyoten)
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Biochemistry		
Instructor Name(担当教員名)	Hiroshi Sakamoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this course, we will cover the structures and functions of major biomolecules including carbohydrates, lipids, proteins, and nucleic acids, to understand the roles of these molecules in metabolism. We will also cover the regulation and coordination of major metabolic pathways. This course has an emphasis on relationships between dideases and metabolic disorders.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course belongs to Module 13 "Functional Proteomics Module" in "Life Science Course".		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Biomolecule 1	carbohydrates, monossacharides, ployssacharides
	2.	Biomolecule 2	amino acids, peptides, proteins, enzymes
	3.	Biomolecule 3	fatty acids, triacylglycerols, phospholipids, steroids
	4.	Biomolecule 4	nucleotides, DNA, RNA
	5.	Biomolecule 5	Vitamins, Pigments
	6.	Metabolism 1	glycolysis, Gluconeogenesis
	7.	Metabolism 2	Tricarbonic acid cycle
	8.	Metabolism 3	Glycogen synthesis and catabolism
	9.	Metabolism 4	Amino acid metabolism, Urea cycle
	10.	Metabolism 5	Nucleotide metabolism
	11.	Method & Techmology 1	Protein Analysis
	12.	Method & Techmology 2	Nucleic acid Analysis
	13.	Method & Techmology 3	Living Cell Analysis
	14.		
	15.		

General Course Policies(授業の進め方)		Each student will introduce a question from USMLE Step1 Biochemistry section and make a full explanation for the question in a seminar style. All students must participate discussion about critical issues provided by the presentator.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This course aims to improve the student's ability to understand and explain the molecular basis of biological phenomenon, that is required for researchers and engineers in health care, medical and biotechnological industry. The course aims to give the student the knowledge needed to:
	Couse objectives (具体的な授業の達成目標)	1. describe the structural and functional properties of biomolecules and their interactions. 2. describe a flow of the metabolic pathways in living cells, tissues and organs. 3. use the knowledge achieved to identify the causes of disease and effects of existing drugs.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluation will be based on in-class participation, presentation and report.
Assignment Instructions (授業外学習(予習・復習)の指示)		Students are expected to prepare PowerPoint materials for their presentation with reffering references shown below. 4 hours aweek in required for preparation and review.
Keywords(キーワード)		carbohydrates, lipids, amino acids, proteins, nucleic acids, metabolism, diseases, drugs,
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		United States Medical Licensing Examination (USMLE) Step1 Qbook (kaplan Medical) Leheninger Principles of Biochemistry, Stryer Biochemistry, Voet Biochemistry, Harper's Illustrated Biochemistry
Notes(備考)		Students will find many helpful resources on the course Moodle site.
Email(電子メールアドレス)		sakakan@bio.kyutech.ac.jp

Course Name(科目名)	Microbiology		
Instructor Name(担当教員名)	Junshi Sakamoto		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Microorganisms have powerful influence of human life in both positive and negative aspects. This lecture describes mecical, industrial and environmental importance of various bacteria, archaea, viruses and eukaryotic microbes.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture expect students to have undergrad-level knowledge of biochemistry, biophysics, and molecular biology.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	evolution and classification	two lectures
2.	growth and sterilization	two lectures
3.	Gram-positive bacteria	two lectures
4.	Gram-negative bacteria	two lectures
5.	archaea and viruses	two lectures
6.	eukaryotic microorganisms	two lectures
7.	medicine, industry and environment	three lectures
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12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		lectures and casual oral exams
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	achieve aims (C) and (H)
	Couse objectives (具体的な授業の達成目標)	1. basic knowledge on diversity of microbes 2. understand how to handle microbes 3. application of microbiology to medical care, industrial production and bioremediation
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		final examination
Assignment Instructions (授業外学習(予習・復習)の指示)		two hour review after every class
Keywords(キーワード)		prokaryotes, fungi, fermentation, Koch, Pasteur
Required Textbooks(教科書)		Microbiology for the Blue Planet and Human Life (Shokabo, ISBN978-4-7853-5216-5)
References/Recommended Reading(参考書)		Biology, for Physical Sciences and Engineerings (Shokabo, ISBN978-4-7853-5231-8)
Notes(備考)		
Email(電子メールアドレス)		sakamoto@bio.kyutech.ac.jp

Course Name(科目名)	Bioanalytical Chemistry		
Instructor Name(担当教員名)	Shinji Sueda		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course deals with the latest techniques on bioanalysis methods based on the protein tagging system with a focus on fluorescence labeling and imaging techniques in living cells. It also enhances the development of students' skills in scientific presentation.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is included in a module "Functional Proteomics Module". The students are expected to understand the basic chemistry and biochemistry in advance.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	Intodcution: Fluorescence imaging	Lecture
2.	Fundamental of fluorescence spectroscopy: part 1	Lecture
3.	Fundamental of fluorescence spectroscopy: part 2	Lecture
4.	Properties of fluorescent proteins	Lecture
5.	Aplications of fluorescent proteins	Lecture
6.	Properties and applications of bioluminescent proteins	Lecture
7.	Fluoresent labeling with tag-probe systems	Lecture
8.	Obsevation of cells by fluorescent microscopy	Lecture
9.	Reading and explanation of references: part 1	Reading and explanation of references
10.	Reading and explanation of references: part 2	Reading and explanation of references
11.	Presentation and discussion: part 1	Presentation and discussion by students
12.	Presentation and discussion: part 2	Presentation and discussion by students
13.	Presentation and discussion: part 3	Presentation and discussion by students
14.	Presentation and discussion: part 4	Presentation and discussion by students
15.	Presentation and discussion: part 5	Presentation and discussion by students

General Course Policies(授業の進め方)		Each topics are provided by the following formats:
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The students are expected to understand bioanalytical methods based on fluorescence imaging and to acquire the basic presentation skills in scientific fields. Specific goals of this course are as follows:
	Couse objectives (具体的な授業の達成目標)	1. Understand the mechanisms and the principles of fluorescence labeling and imaging 2. Understand the imaging techinques with fluorescence microscopes 3. Acquire the basic presentation skills in a scientific field
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Your final grade wil be determined based on the presentation of a scientific paper (50%), the skills of devate (25%), and the report on the references (25%).
Assignment Instructions (授業外学習(予習・復習)の指示)		The students are expected to read the teaching materials distributed on a Moodle system in advance. The participants must find an appropriate scientific paper for presentation by themselves and prepare the materials for presentation. At least four hours should be spent for preparation per week.
Keywords(キーワード)		Bioanalytical chemistry, Protein tagging system, Florescence analysis, Enzyme reaction, Fluorescence imaging
Required Textbooks(教科書)		The teaching materials will be provided on a Moodle system.
References/Recommended Reading(参考書)		Molelcular Biology of the Cell, Fifth edition (Garland Science) Molecular Cloning, Fourth edition (Cold Spring Harbor Laboratory Press) Short Protocols in Protein Science (Wiley)
Notes(備考)		
Email(電子メールアドレス)		sueda@bio.kyutech.ac.jp

Course Name(科目名)	Chemical & Biomedical Engineering		
Instructor Name(担当教員名)	Iori Maeda		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course introduces students taking this course to the basics of the different types of biomaterials that can be applied to regenerative medicine. Students will develop understandings of the organic compounds and proteins used as components of biomaterials. This class also helps students improve their self-study skills by giving presentations using materials that they have prepared themselves for presentation. Students should discuss in detail the assigned theme and the latest scientific papers selected.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This class places to learn basic chemistry knowledge that is essential in the first year of the master's program at the Graduate School of Computer Science and Systems Engineering. This class is also positioned as a course to learn broad biochemical engineering that leads to the research contents of each student.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Chemical basics for the medicine	the basics of chemistry and biochemistry
	2.	What are biomaterials?	definition of biomaterials used in regenerative medicine
	3.	biomaterial polymer	introducing many kinds of biomaterials used in regenerative medicine
	4.	artificial organ	introducing many types of artificial organs used in regenerative medi
	5.	drug delivery system	introducing drug delivery system used in medical field
	6.	material for the biomaterial	problem to be solved in development of biomaterial
	7.	the latest biomaterials	introducing the latest biomaterials
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	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		The first half of the class is in the form of lectures given by teachers. Quizzes to confirm comprehension will be
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This lecture is a bioinformatics subject set up for the purpose of cultivating the basic learning ability required in the information science and engineering and various fields, which is a common learning education goal of the Graduate School of Computer Science and Systems Engineering.
	Couse objectives (具体的な授業の達成目標)	1. Understand the chemical structure of materials 2. Understand the environment that a substance undergoes in vivo 3. Understand the properties of various materials and their issues in application
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Your overall grade in the class will be decided based on the following: - Class attendance and attitude (presentation) in class: 70% - Short reports: 30%
Assignment Instructions (授業外学習(予習・復習)の指示)		preparing the presentation, examining tasks
Keywords(キーワード)		Biomaterial, Drug Delivery System, Elastin
Required Textbooks(教科書)		『ヴィジュアルでわかるバイオマテリアル』(古薗　勉、岡田正弘著、秀潤社)
References/Recommended Reading(参考書)		『ドラッグデリバリーシステムDDS技術の新たな展開とその活用法』(田畑泰彦編集、株式会社メディカルドウ) 『DDS最前線』(金尾　義治著、広川書店)
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Neuroethology		
Instructor Name(担当教員名)	Hideki Nakagawa		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Powe Point slides are used. In this class, at first, history of ethology is summarized. Then, the fundamentals of ethology and signal processing in neural systems are explained. Finally, particularly progressed investigation of neuronal mechanisms underlyaing some kinds of escape behaviors are explained.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This class belongs to systematic biolgy module in life sicence course.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Review for study of behavior	
	2.	The foundamentals of ethology	
	3.	Understandig of signal processing in neural systems	
	4.	Tail flip escape of the crayfish	
	5.	Bending reflex of the leech	
	6.	Collision avoidance behavior of the pigeon	
	7.	Collision avoidance behavior of the locust	
	8.	Term examination	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Powe Point slides are used. In class topic (3), active learning is performed.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Construction of higher information system based on the knowledge of life science and technology
	Couse objectives (具体的な授業の達成目標)	1. Understandig of the fundamentals of ethology 2. Understanding of signal processing of neuronal systems 3. Understanfing of neuronal mechanisms underlying various escape behaviors
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		evaluations of presentation about key wrods in class topics (4)–(7) (20%), term examination (80%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Presentation about key words in class topics (4)–(7). Preparation and review of 4 hours per week
Keywords(キーワード)		Ethology, Neurophysiology, Neuroethology, Escape behavior
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Foundations of Neurobiology, Fred Delcomyn
Notes(備考)		
Email(電子メールアドレス)		naka@bio.kyutech.ac.jp

Course Name（科目名）	Biophysical Chemistry		
Instructor Name(担当教員名）	Hideyuki Komatsu		
Course intended for（対象学年）	1st or 2nd year student		
Credit Category（単位区分）	Elective course	Credits（単位数）	2
Course Description（授業の概要）	Interaction between biological molecules and thier network are based on biological phenomena. This course will provide lectures for physicochemical basis and principles of analytical methods for biomolecular interactions. The applications of analysis will also presented by students.		
Course and Curriculum linkage （カリキュラムにおけるこの授業の位置付け）	This is a course in the module of Functional Proteomics. Students are expected to complete courses for chemistry, physics, biochemistry and molecular biology at undergraduate level.		

Course Calendar/Class Topic （授業計画）		Theme(テーマ)	Contents（内容）
	1.	Thermodynamics of intermolecular interaction	
	2	Thermodynamics of intermolecular interaction	
	3.	Kinetics of intermolecular interaction (1)	
	4.	Kinetics of intermolecular interaction (2)	
	5.	Allostelic effects	
	6.	Intermolecular interaction at the cell	
	7.	Steady state kinetics (1)	
	8.	Steady state kinetics (2)	
	9.	Transient kinetics (1)	
	10.	Transient kinetics (2)	
	11.	Molecular size and shape	
	12.	Calorimetry (1)	
	13.	Calorimetry (2)	
	14.	Calorimetry (3)	
	15.	Summary	

General Course Policies（授業の進め方）		The class has lectures and exercises on the contents of handout. The students must give a presentation related to biophysical chemistry.
Course Objectives （授業の達成目標）	Introduction to Couse Objectives （授業の達成目標の解説）	This course aims to help students to develop "Basic skills required for informatics, technology and other related fields." The course is involved in the research and development in interdisciplinary area of bioinformatics, genomics, proteomics, systems biology and so on.
	Couse objectives （具体的な授業の達成目標）	1. To understand biomolecular interactions in the view point of physical chemistry. 2. To understand principles of analytical methods of biomolecular interactions. 3. To understand how the molecular interactions are related to higher biological functions.
Evaluation Methods and Grading Criteria （成績評価の基準および評価方法）		Exercises 60%, Presentation 40%
Assignment Instructions （授業外学習（予習・復習）の指示）		Students are expected to preview the contents of handouts, to work on the exercises and/or to prepare the presentation slides for 4 hours every week on average.
Keywords（キーワード）		Intermolecular interaction, Thermodynamics, Kinetics, Physical chemistry
Required Textbooks（教科書）		The materials will be handed out.
References/Recommended Reading（参考書）		Physical Chemistry for Life Sciences, Second Edition, Peter Atkins and Julio de Paula
Notes（備考）		
Email（電子メールアドレス）		komatsu@bio.kyutech.ac.jp

Course Name(科目名)	Biomedical Engineering		
Instructor Name(担当教員名)	HIKIMA Tomohiro		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course is designed to learn about a practical application of bioscience and bioinformatics in a medical field, especially about therapeutic system with drug. Students learn the role of drug as biological information and understand the drug administration technology. The students search and discuss the theraputic system.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This is the course to acquire basic knowledge in the biomedical field. The knowledge about an enginerring field have been acquired before registaration of this course.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Pharmaceutical affairs low	
	2.	Drug application process	
	3.	Pharmadynamics	
	4.	Pharmacokinetics	
	5.	Compartment model	
	6.	Drug delivery system	
	7.	Application exsamples about DDS	
	8.	Development exsamples about DDS	
	9.	Disscusion among students I	
	10.	Disscusion among students II	
	11.	Disscusion among students III	
	12.	Disscusion among students IV	
	13.	Disscusion among students V	
	14.	Disscusion among students VI	
	15.	Disscusion among students VII	

General Course Policies(授業の進め方)		Lectures and discussion.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Course objectives are to aquire basic academic skills in the informatiinal science and technology and abilities to find and solve problems.
	Couse objectives (具体的な授業の達成目標)	1. Learn basic knowledge about drug and therapeutic system. 2. Understand about pharmacokinetics and pharmacodynamics. 3. By disccusing amoung students, skills and research minds in th ebiomedical field will be promoted.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Report; 20%, presentation and discussion; 80%,
Assignment Instructions (授業外学習(予習・復習)の指示)		All students should take a time of 4 h in a week for the prepartion of this course.
Keywords(キーワード)		theraputic system, pharmacokinetics, drug delivery system
Required Textbooks(教科書)		Not particularly specified.
References/Recommended Reading(参考書)		Not particularly specified.
Notes(備考)		
Email(電子メールアドレス)		hikima@bio.kyutech.ac.jp

Course Name(科目名)	Introduction to design thinking and medical development management		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Student learn design thinking to search hidden needs in medical and health care systems to develop medical valuable devices and services. In addition, students learn basic spirits of medical care, and business management including insurance reimbursement, pharmaceutical affairs laws, and intellectual property.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Students should learn design thinking and medical system before Biomedical design practices I and II.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Medical innovation	
2.	Design thinking	
3.	System thinking	
4.	Exercise of design thinking I	
5.	Exercise of design thinking II	
6.	Medical systems	
7.	Medial business	
8.	Final examination	
9.		
10.		
11.		
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		Lecture with exercise
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn knowledge and skills of design thinking and basic knowledge of the Japanese medical systems.
	Couse objectives (具体的な授業の達成目標)	1. To learn design thinking. 2. To practice design thinking 3. To understand the medical system in Japan
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Final examination
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		design thinking, system thinking, medical treatment, care, welfare, regulation, insurance, business, medical device, information technology
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Biomedical design practice I		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	One team consists of 2-5 students. Each team works with medical staffs and related persons to empathize and search some problems or needs in hospitals, state the needs, to propose a solution, to make prototype models for solution, to test and improve the models, and to tell a wonderful story to attract all related persons. In practice I, each team finds and defines needs to propose a solution.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Introduction to design thinking and medical development management is necessary.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Learn a hospital and medical system	
	2.	Find hidden needs	
	3.	Define the needs	
	4.	Propose a solution	
	5.	Presentation	
	6.		
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Exercise
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn the processes of empathy, needs finding and definition, solution proposal in design thinking.
	Couse objectives (具体的な授業の達成目標)	1. To learn the processes of empathy with patients, medical staffs, and related persons. 2. To learn the processes of need finding and definition and solution proposal in design thinking. 3. To present the interim presentation.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Peer review among the team members (40%); final presentation (60%).
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		design thinking, system thinking, business, team, medical device and service, information technology
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)	Biomedical design practice II		
Instructor Name(担当教員名)	KURATA, Hiroyuki		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	One team consists of 2-5 students. Each team works with medical staffs and related persons to empathize and search some problems or needs in hospitals, state the needs, to propose a solution, to make prototype models for solution, to test and improve the models, and to tell a wonderful story to attract all related persons. In practice II, each team makes prototype models, tests and improves them, and tells a wonderful story of development.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Biomedical design practice I is required.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Make prototype models	
	2.	Test the model	
	3.	Improve the model	
	4.	Story telling in presentation	
	5.		
	6.		
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Exercise
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Students learn the processes of construction and improvement of prototype models and story telling in design thinking.
	Couse objectives (具体的な授業の達成目標)	1. To make prototype models 2. To test and improve the models 3. To have presentation that attract all related persons.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Peer review among team members (40%); final presentation with products (60%).
Assignment Instructions (授業外学習(予習・復習)の指示)		0.5 hour per one class
Keywords(キーワード)		design thinking, system thinking, business, team, medical device and service, information technology
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		

Course Name(科目名)			
Instructor Name(担当教員名)			
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course lectures on a concept and implementation methods of dependable digital systems which emphasize high reliability. The technical term “dependability” has been used by extending “fault-tolerance”, and one important keyword to realize safe and secure society.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is desired that undergraduate courses ″Computer System I″ and ″Computer System II″ have been taken.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction of dependable systems	
	2.	Dependability Impairments and mean	
	3.	Dependability measures (1)	
	4.	Dependability measures (2)	
	5.	Serial system and parallel system	
	6.	Hardware redundancy: static redunda	
	7.	Hardware redundancy: static redunda	
	8.	Hardware redundancy:dynamic redun	
	9.	Hardware redundancy:hybrid redunda	
	10.	Information redundancy (1)	
	11.	Information redundancy (2)	
	12.	Information redundancy (3)	
	13.	Time redundancy	
	14.	Software redundancy (1)	
	15.	Software redundancy (2)	

General Course Policies(授業の進め方)		This course takes lecture style.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The purpose of this course is to understand the fundamental theory that is used to enhance the reliability of digital systems. It is provided to achieves “(B) learning the necessary fundamentals of computer science, engineering and its application”.
	Couse objectives (具体的な授業の達成目標)	1. Basic concept of dependability 2. Implementation techniques of fault-tolerance 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		reports as a homework (10%) and short examination (90%) in the usual class
Assignment Instructions (授業外学習(予習・復習)の指示)		Spend a time reviewing lessons with distributed course materials for 4 hours per week.
Keywords(キーワード)		dependability, fault-tolerance, reliability, redundant system
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Elena Dubrova, Fault-Tolerant Design, Springer
Notes(備考)		
Email(電子メールアドレス)		kajihara@cse.kyutech.ac.jp

Course Name(科目名)	Advanced OS and Virtualization		
Instructor Name(担当教員名)	Kenichi Kourai		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The purpose of this course is to provide the overview of cloud computing, its technical background, virtualization, and operating systems. The class deals with actual Linux kernel and hypervisor to understand the state-of-the-art of these systems software.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is desirable to have the basic knowledge of operating systems and the C language.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	Introducing this course
	2.	Overview of cloud computing	Providing the overview of cloud computing
	3.	Creating a virtual machine	Creating a virtual machine in a cloud computing platform
	4.	IaaS and cloud computing platforms	Providing the overview of IaaS and cloud computing platforms
	5.	System calls in Linux	Providing the internals of system calls in Linux
	6.	Creating a system call	Implementing a system call in Linux
	7.	Desktop virtualization	Providing the overview of desktop virtualization
	8.	Linux kernel modules	Providing the internals of Linux kernel modules
	9.	Creating a kernel module (1)	Implementing a Linux kernel module (1)
	10.	Creating a kernel module (2)	Implementing a Linux kernel module (2)
	11.	Filesystem and FUSE	Providing the internals of filesystems and the FUSE library
	12.	Creating a filesystem (1)	Implementing a filesystem using FUSE (1)
	13.	Creating a filesystem (2)	Implementing a filesystem using FUSE (2)
	14.	Virtual machines	Providing the internals of virtual machines
	15.		

General Course Policies(授業の進め方)		The class will be presented using both theory and hands-on exercises.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The course objectives are as follows:
	Couse objectives (具体的な授業の達成目標)	1. To obtain the basic knowledge of cloud computing 2. To obtain the knowledge of the internals of an actual operating system by writing programs in Linux 3. To understand the structure of virtual machines
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Students will be evaluated by the reports for exercises.
Assignment Instructions (授業外学習(予習・復習)の指示)		The class will give several programming assignments. Students need to work on optional ones as much as possible. They are required to prepare the class for four hours per week.
Keywords(キーワード)		Cloud computing, virtualization, operating systems, Linux, virtual machines
Required Textbooks(教科書)		Slides are uploaded to moodle.
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		kourai@ci.kyutech.ac.jp

Course Name(科目名)	Advanced Software Engineering		
Instructor Name(担当教員名)	Keiichi Katamine		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Software engineering is a discipline or technology for improving productivity, maintainability and reliability by introducing an engineering approach to the design, development and operation of highly complex software. This lecture teaches basic knowledge and ideas about software engineering.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	As for this course, it is desirable to have learned a software design and an object-oriented methodology.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Overview of Software Engineering	
	2.	Software Development Process	
	3.	Project Management	
	4.	Software Analysis	
	5.	Requirements Analysis	
	6.	Structured Analysis	
	7.	Object Oriented Analysis	
	8.	Architecture Design	
	9.	Module Design	
	10.	Programming	
	11.	Test and Verification	
	12.	Software Maintenance and Reuse	
	13.	PSP/TSP/CMMI	
	14.	Summary	
	15.	Report Issues and Explanation	

General Course Policies(授業の進め方)		This course focuses on lectures. It also involves group works during lectures to understand the contents. In
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The purpose of this course is to help students understand software requirements analysis, design, and implementation. In addition, the goal is to acquire the technology to build an information system in order to solve problems.
	Couse objectives (具体的な授業の達成目標)	1. understand the basic contents of software requirements analysis, design and implementation 2. understand the basic contents of modeling technology and re-engineering technology to solve problems 3. understand the basic contents of the system structure and project management to develop an
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluate the final report (80%) and the small report (20%) that is given during the lecture.
Assignment Instructions (授業外学習(予習・復習)の指示)		Review the previous content at the start of the lecture and review it. At that time, it is desirable to consider whether it can be used in situations such as the methods and techniques learned during the lecture. As a preparatory study, prepare 4 hours a week.
Keywords(キーワード)		Software Development Process, Requirements Analysis, Modeing, Project Management, PSP/TSP
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		N. Takahashi, K. Maruyama, Software Engineering, Morikita-Shuppan IEEE Computer Society, Guide to the Software Engineering Body of Knowledge(SWEBOK) Project Management Institute, A Guide to the Project Management Body of Knowledge(PMBOK Guide)
Notes(備考)		
Email(電子メールアドレス)		katamine@ci.kyutech.ac.jp

Course Name(科目名)	Project Managemnet		
Instructor Name(担当教員名)	Keiichi Katamine, Masanobu Umeda, Keita Asaine		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course explains the concept of general project management and its basic principles, and lectures on the project management for software development based on the concept. It also lectures on critical chain project management.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	In this course, it is desirable to have understood systems engineering, software engineering methodology such as object oriented analysis and design, software engineering including development process and software process, and system technology forcus on software engineering.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction: Requirements Analysis	
2.	Introduction: Conceptual Design	
3.	Introduction: WBS and Project Plan	
4.	Modern Project Management: Project Plan	
5.	Modern Project Management: Time Management	
6.	Modern Project Management: Communication Management	
7.	Modern Project Management: Integration Management	
8.	Modern Project Management: Measurements and Analysis	
9.	Modern Project Management: Risk Management	
10.	Modern Project Management: Quality Management	
11.	Critical Chain Project Management: Theory of Constraints	
12.	Critical Chain Project Management: Synchronization and Resource Management	
13.	Critical Chain Project Management: Critical Chain	
14.	Critical Chain Project Management: Buffer Management	
15.	Presentation of Project Exercise	

General Course Policies(授業の進め方)		Lecture and Exercise
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The following items are the targets.
	Couse objectives (具体的な授業の達成目標)	1. understand the meaning of the project management, its features, and the importance of teamwork. 2. understand and implement how to estimate work and how to make a project plan. 3. understand the contents of the TOC and Critical Chain Project Management.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluate based on the contents of the report and the exercise product.
Assignment Instructions (授業外学習(予習・復習)の指示)		Borrow books related to lectures and use them for preparation and review. Be sure to paricipate actively outside of the lecture hours because you perform project exercise as a group work.
Keywords(キーワード)		Project Management, Project Process, Project Plan, Team Building, Risk Management, Quality Management, TOC, Critical Chain Management
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		Project Management Insitute: A Guide to the Project Management Body of Knowledge(PMBOK Guide) Watts S. Humphrey: TSP Leading a Development Team
Notes(備考)		
Email(電子メールアドレス)		katamine@ci.kyutech.ac.jp

Course Name(科目名)	PBL Cloud System		
Instructor Name(担当教員名)	Noriyuki Kushiro		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In this course, basic technologies required for cloud computing and PBL(system analysis and design methods, project management methods etc.) are lectured at the first sections. After that, students desing and implement a system with cloud computer technologies in mini-PBL sections.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course is a lecture belonging to practical cloud computing modules. The sutudents, who attend this lecture, are expected to take "Advanced project learning for cluod computing".		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Guidance for the lecture and overview for cloud computing	
	2.	System Development Process	
	3.	Methods for Requirement Analysis	
	4.	Method for Planning	
	5.	Mehod for System analysis	
	6.	Mehod for System design	
	7.	Method for Project management on Scrum	
	8.	No SQL	
	9.	Basic technologies for WEB application 1	
	10.	Basic technologies for WEB application 2	
	11.	Methods for Software testing	
	12.	Infrustructure for Cloud computing	
	13.	PBL 1	
	14.	PBL 2	
	15.	PBL 3	

General Course Policies(授業の進め方)		The class wiil be adovanced on the above course calender with PBL style, in which each topic is discussed by a small gourp of students and
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The aim of the lecture is that acheving basic skills for "project-based research and development to nourish ability for solving problems and collaboration". In the lecture, the students are expected to experience system development in PBL, and to master practical skills for system design and project management.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The students are evaluated by portfolios for each topic, and final portfolio after the Mini-PBL, and agressiveness to the lecture and PBL,
Assignment Instructions (授業外学習(予習・復習)の指示)		The students are expected 3 hours preparations for each topic. The class provides the students handouts and video teaching materials for their preparation.
Keywords(キーワード)		System development, Project management, Requirement analysis, System design mehod, Cloud computing
Required Textbooks(教科書)		Doug Rosenberg and Kendall Scott: Use Case Driven Object Modeling withUML, A Practical Approach by Doug Rosenberg Kendall Scott, Addison-Wesley Professional, 1999
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		kushiro@ai.kyutech.ac.jp

Course Name(科目名)	Advanced Computer Graphics Ⅱ		
Instructor Name(担当教員名)	Masaki Oshita		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This class covers advanced techniques on computer graphics and animation. The students can learn practical techniques through lectures and programming exercises. This class is taught in Japanese. Although some materials have English version, most of materials are Japanese only. Reports in Japanese or English are acceptable. A foreign student who are not so fluent in Japanese can still take this class. The students also must have fundamental programming skills of C++. Basic knowledge on		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The students who do not have basic knowledge on computer graphics and OpenGL programming are recommended to take "Advance Computer Graphis I" before this class.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Fundamentals in Computer Graphics	
	2.	Fundamentals in OpenGL Programmin	
	3.	Camera Control	
	4.	Geometry Models	
	5.	Shadow Drawing	
	6.	Keyframe Animation (1): Position	
	7.	Keyframe Animation (2): Orientation	
	8.	Physics Simulation	
	9.	Collision Detection and Picking	
	10.	Character Animation (1): Human Mode	
	11.	Character Animation (2): Forward Kinematics	
	12.	Character Animation (3): Inverse Kinematics and Posture Interpolation	
	13.	Character Animation (4): Motion Interpolation, Connection, and Transition	
	14.	Character Animation (5): Motion Generation, Deformation, and Control	
	15.	Advanced Rendering Techniques	

General Course Policies(授業の進め方)		This is a lecture-style class. Based on the techniques that are taught during class, The students should do
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	To learn advanced techniques on computer graphics and be able to apply them for application software development.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Participation and quizzes during classes (20%) and programming exercises and reports (80%).
Assignment Instructions (授業外学習(予習・復習)の指示)		The students should obtain class materials and read them before class. The students should do programming exercises and submit reports after class.
Keywords(キーワード)		Compute graphics, OpenGL, computer animation, application software development
Required Textbooks(教科書)		None. Class materials are available on the class webpage.
References/Recommended Reading(参考書)		Refences on each topic will be introduced during class.
Notes(備考)		The students must spend at least 4 hours per week for pre-class study.
Email(電子メールアドレス)		oshita@ces.kyutech.ac.jp

Course Name(科目名)	User Modeling		
Instructor Name(担当教員名)	Hidenobu KUNICHIKA		
Course intended for(対象学年)	1st , 2nd or 3rd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	This course provides a methodology for estimating users' thought by a computer. Specifically, methods of estimating and storing the thought process and the knowledge of a user by using computer is provided. Moreover, as an example of using the result of user modeling, a method in which a computer constructs a user model and adjusts the behavior is also described.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This course relates to both Basis of Artificial Intelligence and AI Programming.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	User modeling and knowledge engine	
	2.	Methods of user modeling	Procedural knowledge and declarative knowledge, Formalization of us
	3.	Applications of user modeling	Intelligent Tutoring Systems
	4.		
	5.		
	6.		
	7.		
	8.		
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lecture, programming and presentation
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to achieve the goals "Development of a new mechanism of intelligent information processing in which humans and computers cooperate" for the Division of Artificial Intelligence and "Utilization of the latest information technology and business-oriented research and development based on real-world needs" for the Division of Creative Informatics, the following items are the objectives of this course. These aim to acquire common goal (B) "Basic academic ability required in information science and engineering and various fields" for Graduate School of Computer Science and Systems Engineering.
	Couse objectives (具体的な授業の達成目標)	1. Understanding methods of user modeling 2. Understanding methods of using the results of user modeling 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The degree of understanding , presentations, the participation in discussion will be assessed.
Assignment Instructions (授業外学習(予習・復習)の指示)		Examine the keywords mentioned in the course before and after by using related books or the Web. Note that four hours a week for preparations are necessary.
Keywords(キーワード)		User modeling, Knowledge representation, Thought process, Dialogue systems
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		kunitika@ai.kyutech.ac.jp

Course Name(科目名)	LSI Design		
Instructor Name(担当教員名)	Yutaka ARIMA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	60 years have passed since the invention of LSI (Large Scale Integrated Circuit), and the shrinking of LSI elements is reaching physical and economic limits. What we should learn about this LSI technology now is the best practices of LSI-specific manufacturing and design methods that have continued to improve their performance over the past 60 years. It is also important to understand the development of LSI and semiconductor device technology in a new era that is beyond the limits. In this class, you will be instructed on the trend toward higher performance and lower cost by reducing the element size of LSI. Then, the challenges in element miniaturization and the current situation near the limit will be introduced. In addition, efforts to improve the performance of new LSIs and semiconductor devices will be introduced. It will also introduce innovations related to LSI and semiconductor devices from the perspective of creating value.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This class belongs to the integrated circuit design module, and teaches the key points of technological progress and future development by looking at the high-performance technology of LSIs (large-scale integrated circuits) and semiconductor devices. An overview of the progress of LSI technology as one of the successful cases will be useful as a reference case for those engaged in various R & D other than LSI in the future. This class will provide an insight into the technological history of LSI and semiconductor devices that have evolved so far, as well as the limitations of device miniaturization. In addition, knowing new development examples will enable you to learn how to create value. In this class, it is desirable, but not essential, to have basic knowledge of electronic circuits and semiconductor devices.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Class guidance, LSI evolution, knowledge industry and innovation	
2.	LSI manufacturing technology, unique planar manufacturing technology	
3.	LSI design technology, design points, layout patterns	
4.	Efficient methods for large-scale LSI design, advances in automation	
5.	High value-added by miniaturization of LSI elements	
6.	Issues (limits) and examples of approaches to miniaturization of LSI elements	
7.	New value-added LSI and semiconductor devices	
8.	Development environment for new devices and new technologies	
9.	Objectives and outline of the exercises, Exercise 1	Consideration on abstract needs in innovation examples
10.	Introduction of development case (1)	Neural network LSI with learning function
11.	Introduction of development case (2)	Image sensor LSI with automatic sensitivity adjustment function for each pixel
12.	Exercise 2	Discovering abstract needs and examining lifestyle changes resulting from their solution
13.	Introduction of development case (3)	Lensless near infrared sensor device
14.	Introduction of development case (4)	Real-time 3D range sensor LSI
15.	Summary, other	

General Course Policies(授業の進め方)		In the first half of the class, lectures will be given on LSI-specific manufacturing methods and design methods, as well as element miniaturization technologies that have achieved high performance. In addition, the trends and issues will be introduced, and the actual situation where the miniaturization of elements is approaching the physical and economic limits will be explained. In the latter half of the class, we will give a lecture on high performance that is not based on miniaturization. Introducing several actual LSI development cases and explaining the concept of developing new-function LSIs and high-performance devices that have never existed before. In addition, the importance of technological innovation and the necessary abilities will be explained through two exercises.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In connection with one of the goals of learning and education in the electronics field, (3) `` Construction of advanced information systems with advanced functions of computers '', LSI and semiconductor The aim is to deepen the understanding of high value-added and development methods, and to acquire specialized basic knowledge related to information system technology development focusing on new high value-added LSI devices. This aims to acquire the common learning and education goals of the Graduate School of Information Technology: (B) ″Basic academic skills required in information science and engineering and various fields″ and (C) ″Individual problem-finding and problem-solving abilities″ .
	Couse objectives (具体的な授業の達成目標)	1. Understand the outline and features of LSI design and manufacturing methods. 2. Understand techniques for adding value to LSIs and semiconductor devices. 3. Understand the ability to apply knowledge required for technological innovation.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The achievement goals (1), (2), and (3) above are evaluated based on exercises 1 and 2 (50 points each). Since the evaluation is based on the total score (100 points) of these two reports, the term-end examination is not conducted.
Assignment Instructions (授業外学習(予習・復習)の指示)		Materials used for explanations during lectures will be printed out and distributed. After attending classes, review them based on them, and arrange and reconfirm the contents learned. In that case, if you have any questions, be sure to ask questions or conduct your own research. Preparatory study requires 4 hours a week.
Keywords(キーワード)		LSI, semiconductor integrated circuit, design, miniaturization, added value, semiconductor device, technological innovation
Required Textbooks(教科書)		None.
References/Recommended Reading(参考書)		None. Introduce during the lecture if necessary.
Notes(備考)		
Email(電子メールアドレス)		arima@cms.kyutech.ac.jp

Course Name(科目名)	IC Design		
Instructor Name(担当教員名)	Yutaka ARIMA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The purpose of this class is to understand the basic structure, functional configuration, design method, etc. of an IC (Integrated Circuit) through an actual layout design experience. After explaining the basic knowledge (element structure, operating principle, etc.) necessary for IC design, we will proceed with the explanation along the IC design flow (functional design, circuit design, layout design, verification). On the final day, the verified layout pattern (final form of IC design data) is completed. Students can select the circuit to be designed by themselves. After understanding the design method for each step explained in the class, work on designing and verifying each integrated circuit. The design tools (CAD) necessary for design and verification are installed and used on their own notebook PCs, so they can perform design work outside of class hours. In this lesson, guidance will be given mainly on layout design.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This class teaches the general basic knowledge of ICs (integrated circuits), including the structure and operation principles of semiconductor devices, manufacturing methods, and design techniques, and has the feature of deepening their understanding through actual layout design experiences. . It is desirable, but not required, that students take the following subjects or have equivalent basic knowledge. Electronic circuits, semiconductor engineering.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Class guidance	
	2.	Semiconductor element and CMOS circuit	
	3.	IC manufacturing flow, various manufacturing equipment	
	4.	IC design flow, various design metho	
	5.	Functional design and circuit design	
	6.	Design tools (CAD)	
	7.	Circuit design (netlist generation)	
	8.	Layout pattern design rules	
	9.	Layout pattern design (element level	
	10.	Layout pattern design (gate level)	
	11.	Layout pattern design (circuit configuration)	
	12.	Layout pattern design (IC level configuration)	
	13.	Verification of layout pattern (DRC)	
	14.	Verification of layout pattern (LVS)	
	15.	Test bench (test specification)	

General Course Policies(授業の進め方)		Explains the basic knowledge of semiconductor device structure and CMOS circuit which are indispensable for designing IC (Integrated Circuit), and explains the flow of IC manufacturing and design. Then, according to the design flow, the explanation will proceed in the order of functional design, circuit design, function verification, layout pattern design, layout pattern verification using DRC and LVS. In this lesson, layout design will be taught in detail. Finally, the test methods required to verify the functional performance of the designed integrated circuit are described.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In order to understand the concrete means of realization in connection with one of the goals of learning and education in the electronic field (3) `` Construction of information systems with advanced functions that evolved the principle of computers, '' The goal is to acquire general knowledge of circuit engineering. This aims to acquire the basic learning and education goal of the Faculty of Information Engineering (B) ″Basic academic skills required in information science, engineering and various fields″.
	Couse objectives (具体的な授業の達成目標)	1. Understand the structure and manufacturing method of IC (integrated circuit). 2. Understand IC (integrated circuit) design techniques. 3. Understand the characteristics of semiconductor devices and the configuration of CMOS circuits.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		For the above-mentioned achievement targets (1) and (2), the degree of understanding is evaluated based on the design data (final layout pattern) of the integrated circuit (70%). In addition, (3) is evaluated in the test specification for functional performance evaluation of the designed circuit (30%). As described above, the degree of understanding is evaluated by the design layout pattern of the integrated circuit and the test specification, so that the term-end test is not performed.
Assignment Instructions (授業外学習(予習・復習)の指示)		Materials used for explanations during lectures will be printed out and distributed. After attending classes, review them based on them, and arrange and reconfirm the contents learned. Individual design tasks can be performed using design tools that are installed on their own notebook PCs. When designing a circuit of a reasonable scale, design work outside the class is required. Preparatory study requires 4 hours a week.
Keywords(キーワード)		Semiconductor, integrated circuit, IC, design, electronic circuit
Required Textbooks(教科書)		None.
References/Recommended Reading(参考書)		None. Introduce during the lecture if necessary.
Notes(備考)		
Email(電子メールアドレス)		arima@cms.kyutech.ac.jp

Course Name(科目名)	Organic semiconductor devices		
Instructor Name(担当教員名)	Kazuyuki Nakamura		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Semiconductors are the base material of various electronic elements (parts), and many faculty members of the three campuses of the KIT are engaged in education and research on various related technologies. There are also many joint research labortories on related themes. In this lecture, these teachers will collaborate and provide the latest technology and topics in a relay system using a TV lecture system that connects the remote campuses. Specifically, in addition to semiconductor element processing methods (process fields), electronic device structures (device fields), large-scale integrated circuits and LSIs (system fields), micro-mechanical devices MEMS (Micro Lecture on Electro-Mechanical Systems) (MEMS field). [Notes] The classes will be held on Thursday classes common to the three campuses for three-campus cooperative lectures.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)			

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Overview	
	2.	Manufacturing method of 3D (stacked) LSI	
	3.	Semiconductor surface nanotechnology	
	4.	LSI test and power analysis	
	5.	Solid material devices and numerical analysis	
	6.	Organic semiconductor devices	
	7.	Digital integrated circuit	
	8.	Medical and biological applications of microfluidic devices	
	9.	Switching power supply integration technology	
	10.	Reconfigurable devices and application	
	11.	Real-time 3D distance sensor	
	12.	Medical and bio-application of MEMS	
	13.	MEMS and thermal engineering	
	14.	Memory LSI and applications	
	15.	High-speed interface design	

General Course Policies(授業の進め方)		The three campuses are connected by a TV lecture system and a remote lecture is conducted. Students should
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Evaluate at least one report from each field of process, device, system, and MEMS, and one report from any field, for a total of five reports. (No final exam will be conducted)
Assignment Instructions (授業外学習(予習・復習)の指示)		Two hours a week for lecture preparation and review (making reports) are required.
Keywords(キーワード)		
Required Textbooks(教科書)		No textbook is used in this lecture. Some materials are supplied in class.
References/Recommended Reading(参考書)		
Notes(備考)		
Email(電子メールアドレス)		nakamura@cms.kyutech.ac.jp

Course Name(科目名)	High Reliability Design		
Instructor Name(担当教員名)	Xiaoqing Wen		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	Test for determining whether a manufactured LSI circuit operates properly is extremely important for the reliability of the system to which the circuit is applied. Due to the ultra-large scale and ultra-miniaturization of LSI circuits, low test quality and high test costs are becoming a major problem. This course outlines the role of test design in the LSI design and the manufacturing process. It also covers the basics of test methods, test		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This lecture belongs to the LSI module, and covers the test part of LSI design, manufacturing, and test. Since it is impossible to completely prevent errors from occurring in design and manufacturing, it is necessary to accurately check whether the manufactured LSI circuit operates properly and prevent defective products from leaking to the market. is important. In testing, it is required to have the basic knowledge of targeted logic circuits and algorithms on which test methods are based. It is assumed that undergraduate courses, such as ″Computer Network E″ and ″Digital System Design″, have been taken.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction to LSI Test	
	2.	LSI Test Basics	
	3.	Fault Models	
	4.	Fault Simulation	
	5.	Testability Analysis	
	6.	Basics of Combinational ATPG	
	7.	Major ATPG Algorithms	
	8.	Mid-Term Eaxm	
	9.	Basics of Design for Testability	
	10.	New Trends in LSI Test	
	11.	Test Compression	
	12.	LSI Test Power Safety	
	13.	Summary	
	14.	Final Exam	
	15.	Final Exam Review	

General Course Policies(授業の進め方)		During class hours, lectures will be given according to the above schedule. You will also be required to submit
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In this course, in order to realize the learning and educational objective of the Department of Creative Informatics, (1) ″utilize the latest information technology for practical research and development to meet real-world needs″, the goal is to learn the LSI test technology that affects the reliability of semiconductor integrated circuits that form the foundation of modern industry and society. This course controbuts to the raelization of the common learning and educational objective of Graduate School of Computer Science and Systems Engineering, (B) ″academic skills required in each field related to information science and engineering″.
	Couse objectives (具体的な授業の達成目標)	1. Understand the importance of LSI test in the semiconductor industry 2. Understand the basic technology of LSI test (fault model, test generation, design for testability) 3. Understand advanced technologies in LSI test (test compression, low power test, high quality test) 4. Understand future trends in LSI test
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		For (1) to (4), grade evaluation will be based on the total score of the mid-term exam (out of 50 points) and the final exam (out of 50 points).
Assignment Instructions (授業外学習(予習・復習)の指示)		By the day before taking the class, download the materials for the lecture from the designated site and perform the preparation study (preparation). At least 4 hours need to be spent on preparation every week. If you have any questions, please send them to the lecturer in advance (wen@cse.kyutech.ac.jp). In addition, A4 papers need to be used for homework reports.
Keywords(キーワード)		Test, Fault, Test Pattern, ATPG, Scan Design, BIST
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		1. T. Yoneda, S. Kajiwara, and T. Tsuchiya, ″Dependable System″, Kyoritsu Publishing. 2. L.-T. Wang, C.-W. Wu, and X. Wen, (Editors), ″VLSI Test Principles and Architectures: Design for Testability″, San
Notes(備考)		
Email(電子メールアドレス)		wen@cse.kyutech.ac.jp

Course Name(科目名)	System-LSI Design		
Instructor Name(担当教員名)	Kazuyuki Nakamura		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	In order to learn the circuit design technology of the system LSI in the analog / digital (A/D) mixture era, PLL (phase synchronization loop :Phase-Locked-Loop) circuit will be taken as a subject of the design target. An analog circuit design tools (ns-spice) will be employed to design the PLL circuit.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	They learn MOS transistor and CMOS logic gate, the circuit components of PLL (phase frequency detector, voltage controlled oscillator, etc.) and design and simulate them by using SPICE to understand the operations.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Basics of Circuit Simulations	
2.	Analog / Digital Mixed Circuit Design using SPICE	
3.	Overview of PLL Circuit and its Appliations	
4.	Design of PLL Components I (Phase-Frequency Detector, Frequency Divider)	
5.	Design of PLL Components II (Low-pass Filter, Charge-pump, Voltage Controlled Oscillator)	
6.	Whole PLL Operation using Ns-spice	
7.		
8.		
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10.		
11.		
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		At first, students learn usage of analog digital mixture circuit simulator (ns-spice) working on a PC. Finally they
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		The different specifications for the PLL design will be given to each student as a final report subject. Confirming stable lock operation of PLL by whole simulation by spice and submitting the report of the result are condition of the obtaining the unit.
Assignment Instructions (授業外学習(予習・復習)の指示)		Four hours a week for lecture preparation and review are required. Final PLL Design report will be required.
Keywords(キーワード)		SI, Circuit Design, SPICE, Verilog, VHDL, Circuit Simulator, Phase-Locked Loop, Analog / Digital Mixed Circuits
Required Textbooks(教科書)		No textbook is used in this lecture. Some materials are supplied in class.
References/Recommended Reading(参考書)		1. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill Companies 2003 2. N.Weste, D.Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Addison Wesley 2010
Notes(備考)		
Email(電子メールアドレス)		nakamura@cms.kyutech.ac.jp

Course Name(科目名)	Real Time System		
Instructor Name(担当教員名)	Masanobu KOGA		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	More efficient production of high-precision and high-quality product is required in the industry. It becomes more important to design the product based on the high-precision model which represents the physical phenomena more accurately. Because more complex computation is required for the design, it is essential to use CAD software which helps us from design process to manufacturing process. Although CAD software is used as black-box commonly, this course deals with how CAD software works and how to implement it in order to deepen understanding and enhance application skills of CAD software. And the data processing for manufacturing process and real-time process are explained in the couse.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	This couse belongs to the software module and deals with how CAD for control systems works, how to implement CAD for control systems, and real-time process. Students are expected to have learned basic numerical analysis, basic theory of control systems, and C programming language.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	CAD for control systems	
	2.	Language processors	
	3.	Data type and data format	
	4.	Numerical error	
	5.	Matrix computation (1)	
	6.	Matrix computation (2)	
	7.	Polynomial computation	
	8.	Computation of differential equations	
	9.	Simulation of control systems	
	10.	Modeling and simulation	
	11.	Introduction to embedded system	
	12.	Real time periodical process	
	13.	Real time control	
	14.	Development of software for computing	
	15.	Explanation of final examination	

General Course Policies(授業の進め方)		Mainly lecture-based course with imposing reports assignments
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	This course has the goal of acquiring the basic knowledge of software for control systems. It aims to achieve the goal of acquiring the knowledge and skills for research and development based on the requirements in the society using the current information technology.
	Couse objectives (具体的な授業の達成目標)	1. 2. 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Report assignments(60%), term-end exam or final report assignment(40%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Students are expected to take more than four hours for homework every week.
Keywords(キーワード)		Simulation, real-time system, data processing
Required Textbooks(教科書)		None (Instructor will supply prints in class)
References/Recommended Reading(参考書)		Masanobu Koga, MaTX for control and numerical analysis, tokyo denki university press
Notes(備考)		None
Email(電子メールアドレス)		koga@ces.kyutech.ac.jp

Course Name(科目名)			
Instructor Name(担当教員名)			
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	The human interface is between a user and a computer system and it is connects them. The human interface is an very important factor to evaluate a computer system and an application. This lecture systematically deals with the entire interface system such as the input / output device mechanism, toolkit, and applications. In addition, the latest interfaces, interfaces using pattern recognition, multimodal interfaces, and real world oriented interfaces, are explained. Finally, we discuss about how to evaluate interfaces.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	The lecture belongs to the graphics and application module, and learns about the user interface mainly through the most used graphical user interface (GUI) through lectures and exercises. The aim of the lecture is to understand the aspects of ergonomics and the mechanisms of various human interfaces, learn how to evaluate human interface devices, and deepen the technical understanding through exercises to create a prototype system. The lecture assumes that you understand the framework of the computer system, which is the core of the human interface, and that you can program applications using JavaScript and/or other programs.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Human and human computer interact	
	2.	Design of dialogue system	
	3.	Input interface	
	4.	Visual interface	
	5.	Voice interface	
	6.	Gesture interface	
	7.	Spatial interface	
	8.	GUI creation practice and evaluation	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		Lectures will be given for each item and exercises will be held as appropriate.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In the lecture, you shall achieve a part of learning and educational goals in the Department of Information Creation Engineering. The goal is to acquire both ergonomic and technical aspects of the human interface.
	Couse objectives (具体的な授業の達成目標)	1. The goal is to acquire both ergonomic and technical aspects of the human interface. 2. Therefore, you shall acquire (B) "Basic academic skills required in information science / engineering and various fields" which is a common learning education goal in the Graduate School of Information 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Comprehensively evaluate through exercises and reports.
Assignment Instructions (授業外学習(予習・復習)の指示)		For undestanding the user interface, you shall create a web application using JavaScript and HTML. In the lecture, there is only a simple explanation, so you need to learn by yourself. As a preparatory study, you need 4 hours a week.
Keywords(キーワード)		Human interface
Required Textbooks(教科書)		Distribute lecture materials
References/Recommended Reading(参考書)		Human Computer Interaction, Okada et al(Ohmsha) Human Machine Interface Design, edited by Makoto Yoshida(Kyoritsu Publishing) Human interface, edited by Hiroshi Tamura(Ohmsha)
Notes(備考)		
Email(電子メールアドレス)		ohashi@isc.kyutech.ac.jp

Course Name(科目名)	Advanced Backend Phase of LSI Design		
Instructor Name(担当教員名)	Kohei Miyase		
Course intended for(対象学年)	1st or 2nd year student		
Credit Category(単位区分)	Elective course	Credits(単位数)	2
Course Description(授業の概要)	When an LSI is designed, many techniquies are utilized. Even in backend phase of LSI design, logic sysnthesis, layout design, verification, design for testability, test pattern generation, and power analysis are included. In this lecture, basic techniques are introduced, and then some detail techniques are discussed.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	It is desired that undergraduate courses "Computer System I" and "Computer System II" have been taken.		

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Introduction of LSI design	
2.	Logic synthesis	
3.	Logic simulation	
4.	Understanding circuit description	
5.	Reading and storing design informati	
6.	Reading, storing, and utilizing strings	
7.	Power analysis	
8.		
9.		
10.		
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13.		
14.		
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General Course Policies(授業の進め方)		This course takes lecture style.
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	The purpose of this course is to understand the fundamental theory that is used to enhance the reliability of digital systems. It is provided to achieves "(B) learning the necessary fundamentals of computer science, engineering and its application". More details are given as follows:
	Couse objectives (具体的な授業の達成目標)	1. Basic concept of LSI design 2. How to impliment a new techniques in a programer's point of view 3.
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Reports as a homework.
Assignment Instructions (授業外学習(予習・復習)の指示)		Spend a time reviewing lessons with distributed course materials. (4 hours)
Keywords(キーワード)		LSI design, backend design, logic synthesis, layout, verification, design for test, test generation, power analysis
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		「システムLSI設計工学」藤田昌宏 編著、オーム社 「VLSI設計工学 SoCにおける設計からハードウェアまで」藤田昌宏、数理工学社 「図解でわかる半導体とシステムLSI」菊池正典 監修、日本実業出版社
Notes(備考)		
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