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 Granding 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)	Advanced modern 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 and required course	Credits(単位数)	2
Course Description(授業の概要)	Modern control theory concerns the analysis and design of control systems based on the state space representation. This course focuses on robust control methodologies for linear systems. Topics include: Quantitative analysis of controllability and observability, model reduction based on the balanced realization, disturbance observer, discretization, non-minimum phase systems, servo control.		
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.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Quantitative analysis of controllability and observability (1)	
	2.	Quantitative analysis of controllability and observability (2)	
	3.	Balanced realization and model reduction	
	4.	State estimation	
	5.	Disturbance observer	
	6.	Servo control (1)	
	7.	Servo control (2)	
	8.	Two dgrees of freedom control systems	
	9.	Non-minimum phase systems (1)	
	10.	Non-minimum phase systems (2)	
	11.	Discretization	
	12.	Discrete-time control systems	
	13.	Sampled-data control systems (1)	
	14.	Sampled-data control systems (2)	
	15.	Kalman filter	

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 introduce advance topics of modern control theory.
	Couse objectives (具体的な授業の達成目標)	1. The students should be able to apply model deduction based on the balanced realization. 2. The students should be able to analyse and synthesise sampled-data control systems. 3. The students should be able to synthesise servo 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)	Modern control theory, controllability and observability gramians, banaced realization, servo control, non-minimum phase systems, smapled-data control	
Required Textbooks(教科書)	None	
References/Recommended Reading(参考書)	None	
Notes(備考)		
Email(電子メールアドレス)		

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)	Advanced Linear Algebra			
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)	1
Course Description(授業の概要)	Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices.This course covers matrix theory and norms of vectors, matrices and signals.			
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 basic linear algebra, such as matries and vectors.			

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Eigenvalues and eigenvectors	
	2.	Positive and negative definiteness of matrices	
	3.	Singular varlue decomposition	
	4.	Rank reduction and approximation of matrices	
	5.	Kronecker products	
	6.	Norms of vectors and matrices	
	7.	Norms of signals	
	8.	Additional explanation	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	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)	This course introduces the some concepts of matrices, such as singular values, positive and negative definiteness. Also the norms of vectors, matrices and signals are introduced in this course.	
	Couse objectives (具体的な授業の達成目標)	1. The students should be able to understand the notions of singular values and definiteness of matrices.	
		2. The students should be able to understand the norms of vectors, matrices and signals.	
		3.	
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)		Positive definiteness, Singular values, Kronecker product, norms of vectors, matrices, and signals	
Required Textbooks(教科書)		None	
References/Recommended Reading(参考書)		None	
Notes(備考)			
Email(電子メールアドレス)			

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".		
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	
	2.	Succinct Data Structure: rank, select	
	3.	Succinct Data Structure: rank, select for sparse bit vectors	
	4.	Succinct Data Structure: Wavelet Tree	
	5.	Succinct Data Structure: Range Minimum Query	
	6.	Succinct Data Structure: Succinct Tree	
	7.	Grammar Compression	
	8.	Fundamental Operations on Grammar Compression	
	9.	SLP-index	
	10.	Longest Common Extensions on Grammar Compression	
	11.	LZ-index	
	12.	BWT	
	13.	FM-index	
	14.	r-index	
	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		
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	
	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 Granding 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, Indexing, Algorithms and Data Structures		
Required Textbooks(教科書)	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		
References/Recommended Reading(参考書)			
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 systems	
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.		
Course Objectives (授業の達成目標) — 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 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 Granding 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 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 Granding 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)	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 machines	
2.	The object-oriented paradigm and type systems	
3.	Garbage collection and weak references	
4.	Garbage collection techniques	
5.	Structures of language systems and compilers	
6.	Implementation techniques for parallel language systems	
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		1 to 5 lectures on each topic are given. Remote lectures for fifteen times lectures are given in a combination of asynchronous and synchronous styles. Live Zoom is used for answering questions. Moolde is used for providing on-demand videos. Attendance checks are based on Moodle submissions. Students are 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)	
	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 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 and tone curve	
	3.	2D image processing: spatial filtering	
	4.	2D image processing: frequency filtering	
	5.	2D image processing: 2D geometric transformation	
	6.	2D image processing: segmentation and matching	
	7.	Video image processing	
	8.	Image pattern recognition: basic approaches	
	9.	Image pattern recognition: supervised/unsupervised learning	
	10.	3D image processing: geometric approaches	
	11.	3D image processing: stereo vision	
	12.	3D image processing: photometric approaches	
	13.	3D image processing: inverse rendering	
	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 reflection	
	8.	Measurement and modeling of scattering	
	9.	Measurement and estimation of illumination	
	10.	Shape recovery: shape from shading	
	11.	Shape recovery: photometric stereo	
	12.	Exercise 3	
	13.	Computational photography: light field	
	14.	Computational photography: coded aperture/exposure	
	15.	Computational photography: active illumination	

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.
	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 Granding 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)	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 example	
	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. On-demand lectures (8 times) and face-to-face lectures (7 times) will be given according to the description of the Moodle course. On-demand class attendance is confirmed by the submitting a report.
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 2. Understand the basics of first-principles calculation. 3. Make a first-principles calculation code and calculate the electronic structure of various electronic
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)		The report (50%) and presentation (50%).
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. We 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 Course on Microelectronic Systems		
Instructor Name(担当教員名)	BABA Akiyoshi		
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.		

Course Calendar/Class Topic (授業計画)

	Theme(テーマ)	Contents(内容)
1.	Position of micromachining in the entire product	Lecture on positioning of microfabrication from the perspective of microdevice products such as LSI and MEMS
2.	Processing technology (classification by size)	Lectures on size effects of physical quantities and the relationship between size effects and processing methods.
3.	Substance and Energy	Lectures on the concept of matter and energy to understand the ions and radicals used in microfabrication.
4.	LSI processing technology (planar technology)	Lecture on planar technology used in LSI fabrication, a representative of microfabrication
5.	Film growth / deposition	Lectures on CVD method, sputtering method, and spin coating method, which are important film deposition methods in LSI manufacturing.
6.	Photolithography	Lecture on photolithography techniques used in planar technology
7.	Etching	Lecture on the types and characteristics of etching and etching methods in specific situations
8.	Doping and substrate cleaning	Lecture on the outline of doping technology and substrate cleaning technology, equipment principle, and process
9.	MEMS technology	Lecture while comparing the features of MEMS technology with LSI technology (planer technology)
10.	Specific MEMS technology	Lecture on MEMS-specific technologies, application methods, and applicable devices
11.	Process integration	Lecture on the outline of integration technology, which is a combination of elemental technologies, and the integration technology of specific microdevices.
12.	Process margein	Lectures on process margins in LSI and MEMS technologies for each major process, and lectures on the impact on final yield.
13.	Fusion technology of LIS and MEMS	Lecture on how to integrate MEMS technology and LSI technology (planar technique)
14.	3D LSI	Lecture on 3D LSI fabrication technology as an example of a fusion device of MEMS technology and LSIM technology (planer technology)
15.	Explanation of report issues	Explain the reporting issues related to process integration

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 Ganding Criteria (成績評価の基準および評価方法)	Evaluate grades on the following two tasks ・ Assignments given after each lecture: 2 points x 15 times (30 points in total) ・ Report assignment on process integration after the lecture: 70 points	
Assignment Instructions (授業外学習(予習・復習)の指示)	At the end of the lecture, we will inform you of the next lecture schedule. Read and prepare for the materials corresponding to the schedule. Also, review the content of the lecture and be prepared to ask questions before the next week's lecture or by email. As a preparatory study (preparation), secure 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)	MoodleコースURL https://ict-i.el.kyutech.ac.jp/course/view.php?id=2884	
Email(電子メールアドレス)	baba@cms.kyutech.ac.jp	

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 and Buettker foumulas.
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.	Practical study	Practical study using related manuscripts in English
13.	Practical study	Practical study using related manuscripts in English
14.	Practical study	Practical study using related manuscripts in English
15.	Practical study	Practical study using related manuscripts in English

General Course Policies(授業の進め方)		Online Lecture by zoom meeting 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).
		Prestudies 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. Corresponding moodel course offers professional slides necessary for study and articles for execise.
References/Recommended Reading(参考書)		J. H. Davies: The Physics of Low-Dimensional Semiconductors (Cambridge Univeristy Press, Cambridge, 1998)
Notes(備考)		This course will be given in online zoom meeting, not a face-to face lecture. 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)	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 conductivity, perfect diamagnetizm)	
	2.	Types of superconductors (Type 1 and Type 2)	
	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 critical magnetic field	
	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)	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 complexity	
2.	An overview of parallel processing	
3.	Complexity of a parallel algorithm	
4.	Basic techniques for parallel algorithms 1 (divide-and-conquer and data parallel processing)	
5.	Basic techniques for parallel algorithms 2 (work-pool approach)	
6.	Recent topics for parallel and distributed processing 1 (Quantum computing)	
7.	Middle exercise	
8.	An overview of distributed processing	
9.	Basic distributed algorithms 1 (leader election)	
10.	Basic distributed algorithms 2 (logical and vector clocks)	
11.	Recent topics for parallel and distributed processing 2 (DNA computing)	
12.	Recent topics for parallel and distributed processing 3 (Membrane computing)	
13.	Recent topics for parallel and distributed processing 4 (Blockchain)	
14.	Final exercise	
15.	Exam	

General Course Policies(授業の進め方)		The lecture is a hybrid of in-person classes and remote classes. For the in-person class, materials for the lecture are distributed electrically. For the remote class, videos and exercises are prepared in advance, and attendance of the lecture is recorded by solving the exercise. The final exam is a written examination.
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 two report assignments (20%) and the final exam (80%).
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)		none
Notes(備考)		
Email(電子メールアドレス)		fujiwara@cse.kyutech.ac.jp

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)	This class will be used video. You have to downroad PDF document from moodle. The number of lectures will be 15 times. In this class, you will be evaluated by your reports.	
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 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 network	Introduce the latest trend of wireless mobile network
	2.	Introduction and explanation of allocated tasks and papers	Introduce the duties for each students and explain the allocated pap
	3.	Changes in wireless mobile network (mobility, wireless, multi-home)	
	4.	Overview of wireless mobile network	
	5.	Mobility management protocol (e.g., Mobile IP)	
	6.	Trends of sensor networks	
	7.	Trends of cognitive radios	
	8.	Edge network platform for cross-domain data fusion	
	9.	Preperation for presentation and discussion (I)	
	10.	Preperation for presentation and discussion (II)	
	11.	Presentation (I)	
	12.	Presentation (II)	
	13.	Presentation (III)-backup and preperation for final report	
	14.	Submission of final report	
	15.	Wrap-up meeting	

General Course Policies(授業の進め方)		Until 10th class, the instuctor explain in the lecture style. After that, the students need to hand in reports and have a presentation. In this cource, the expers from other organization including universties and companies are invited as the external instructor.
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.
	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)		This lecture is a remote learning course using Zoom and Moodle.
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 Ganding 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)	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)	This class will be conducted both remotely and face-to-face using Moodle and Zoom. Students will devise a system, make a prototype, and give a presentation about their system. Attendance will be checked using Zoom and Moodle. In the last class, an exam will be given remotely using Zoom. This course will be taught in English. Students are required to discuss 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)	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)	Robustness and stability of dynamical systems		
Instructor Name(担当教員名)	Hiroshi Ito		
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 concepts of stability and robustness are two major tools for dealing with dynamical systems . This course focuses on them in view of both internal and external behavior. The emphasis is on mathematical concepts and formulations which are applicable to both nonlinear and linear 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 covers materials which are based on fundamental concepts in classic and modern control theory. Knowledge on them will greatly help learners. Differential equations, linear algebra, Fourier series and Laplace transform are the mathematical basis of this course. .		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Dynamical systems	
	2.	Linearity and nonlinearity of dynamics	
	3.	Solutions to system equations and their characteristics	
	4.	Estimation of system solutions	
	5.	General formulation of contraction	
	6.	Equilibria, invariant sets and limit cycles	
	7.	Internal stability	
	8.	Dissipativity	
	9.	Input-output characterization	
	10.	Lyapunov functions	
	11.	Stabilizability and detectability	
	12.	Stability of interconnected systems	
	13.	Robust stability	
	14.	Robust performance	
	15.	Stabilization and robustification	
General Course Policies(授業の進め方)	This course will be given in the lecture format. Communication with students through exercise assignments during classes will bridge the gap between theory and real word phenomena , and it helps the students understand abstract and mathematical formulations of dynamics . Students are asked to take notes including their own thought they go through during the exercises. The notebooks will be submitted along with the final assignment.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Learning tools for characterization and analysis of dynamical systems is the major objective. It allows one to acquire basic knowledge's needed for designing dynamical systems supporting and developing modern societies and technologies.	
	Couse objectives (具体的な授業の達成目標)	1. Understanding the concept of stability and being able to apply it appropriately 2. Analyzing and compensating dynamical systems through appropriate characterization 3. Understanding robustness concepts and using them to analyze and design dynamics	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Grading is based on performance of homework assignments (100 per cent).		
Assignment Instructions (授業外学習(予習・復習)の指示)	Note-taking is essential. Students are advised to read handouts before lectures and review them and their notebooks carefully. The minimum of four hour study at home is necessary each week.		
Keywords(キーワード)	Linear systems, Nonlinear systems, Dynamics, Stability, Robustness, Equilibria, Feedback control, Control theory		
Required Textbooks(教科書)	Handouts will be distributed.		
References/Recommended Reading(参考書)	Information will be given in class.		
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）	This course deals with numerical methods for stochastic differential equations (SDEs). SDEs can describe physical phenomenon, in which we have to consider random effects, such as in bio-chemical reactions. However, in many cases we cannot solve them analytically. Thus, we need numerical methods for them, and in fact, such methods have been studied and have been developed in the recent thirty years. In this course, we start from the introduction to SDEs, and have numerical methods for SDEs. In the end, students will be required to write program codes for the methods and carry out simulation.		
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 want to take this course, will be expected to have fundamental knowledge about probability, stochastic processes, differential equations, and numerical analysis. However, they do not need to have advanced knowledge about all of them. Corresponding to a situation, supplemental explanations will be given to the students.		

Course Calendar/Class Topic
（授業計画）

	Theme(テーマ)	Contents（内容）
1.	Introduction, probability and random variables	(Contents are clearly indicated by the title in each theme)
2.	limit theorems, stochastic processes	
3.	Stochastic integrals and Ito Theorem	
4.	Stochastic differential equations	
5.	Numerical methods for SDEs	
6.	Applications of SDEs, stochastic stability	
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General Course Policies（授業の進め方）		In addition to lectures about the subjects, exercises or reports can be required.
Course Objectives （授業の達成目標）	Introduction to Couse Objectives （授業の達成目標の解説）	We aim at a level in which students can numerically solve SDEs for applications. For this, our course objectives are as follows:
	Couse objectives （具体的な授業の達成目標）	1. Students understand basic theories related to SDEs. 2. Students can write program codes to implement numerical methods for SDEs. 3. Students can carry out numerical simulations related to SDEs.
Evaluation Methods and Grading Criteria （成績評価の基準および評価方法）		Students are required to submit reports. In the reports, the following are checked mainly: 1) description about subjects, 2) investigation about subjects, 3) understanding about subjects, 4) how well organized reports as a whole.
Assignment Instructions （授業外学習（予習・復習）の指示）		After each lecture, it would be better for students to check their understanding of the lecture by reading their note and the materials handed out. It might takes approximately one hour, but it depends on students.
Keywords（キーワード）		Stochastic differential equation, numerical method, approximation, numerical stability, stochastic Runge--Kutta method.
Required Textbooks（教科書）		Students do not need to buy a text. Prints will be handed out.
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, Morikita (in Japanese).
Notes（備考）		
Email（電子メールアドレス）		komori@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）	If a face-to-face class is available, it will be conducted in a face-to-face lecture format. If a face-to-face class is not possible, the class will be conducted in an on-demand format (asynchronous). In this case, lecture materials and videos will be uploaded before the lecture date, and attendance will be confirmed by a mini-quiz.	
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）	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. Some application examples will be presented to deepen understanding of the methods.		
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 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）	This lecture aims 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)	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)		Online video/slide classes (mostly), face-to-face classes (several times), and zoom classes (several times)
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 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 with equality constraints
	4.	Optimality condition 2	Optimization problems with inequality constraints
	5.	Optimization method 1	Golden section method
	6.	Mid-term exam	Midterm exam and its review
	7.	Optimization method 2	Convergence rate, Steepest descent method, Newton's method
	8.	Optimization method 3	Trust region method etc.
	9.	Optimization method 4	Penalty function method, Barrier functin method etc.
	10.	Convex programming	Convex set, Convex function, Convex programming problem
	11.	Duality	Dual problem, Duality theorem
	12.	Support vector machine 1	Problem formulation, SVM with soft margin
	13.	Support vector machine 2	Variety of SVMs
	14.	Neural network optimizaiton 1	Problem formulation, NN as an optimization problem
	15.	Neural network optimizaiton 2	Variety of optimization methods for NNs

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.	Introduction of machine learning	
	2.	Machine learning exercises	
	3.	Multilayer perceptron	
	4.	Database for image recognition	
	5.	Convolutional neural network (1)	
	6.	Convolutional neural network (2)	
	7.	Convolutional neural network (3)	
	8.	Image data collection	
	9.	Style transfer	
	10.	Recurrent neural network	
	11.	Explainable AI	
	12.	Presentation (1)	
	13.	Presentation (2)	
	14.	Presentation (3)	
	15.	Summary	

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 in journals and international conferences are explained. Read a selected paper presented at journals and international conferences on image processing, summarize it as slide, and give presentations once per student. Exersice using Google Colab.	
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, the common learning and education goals of the Faculty of Information Technology are (B) "Basic academic ability required in information science and engineering and each field", and the learning and education goals of System Design and Informatics (1) "Advanced". In order to acquire the ability to "solve problems as an advanced information engineer based on conventional information technology", through the latest research on image processing presented at international conferences in recent years, in recent years in this field Understand trends.
	Couse objectives (具体的な授業の達成目標)	1. Learn the research field of image recognition. 2. Understand the latest research trends in image recognition. 3. Implement image recognition task using a convolutional neural network.
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 quizzes (10%), exercises (50%), reports (30%), and presentation (10%)	
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)	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)	We are planning the following(March 1st 2021). The lectures are given asynchronously. The lecture materials corresponding to the above class contents, movies or slides, are given on the Moodle course. The students access to the materials and studies the above contents. Reports will be imposed every time and submitting the reports will be understood as the attendance at the lecture. Questions from students will be accepted with Moodle message or email suitably, and the answers will be explained to the whole of students with Moodle. If necessary, we take the quetsion time with zoom suitably.		
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)	tagami@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 from the viewpoint of algebraic combinatorics. We start with a basis of number theory and construct interesting combinatorial structures as an application of number theory. 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, classification	
	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 property	
	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 codes	
	13.	The Hamming bound and perfect codes	
	14.	Cyclic codes, I	
	15.	Cyclic codes, II	

General Course Policies(授業の進め方)	We are planning the following(March 1st 2021). The lectures are given asynchronously. The lecture materials corresponding to the above class contents, movies or slides, are given on the Moodle course. The students access to the materials and studies the above contents. Reports will be imposed every time and submitting the reports will be understood as the attendance at the lecture. Questions from students will be accepted with Moodle message or email suitably, and the answers will be explained to the whole of students with Moodle. If necessary, we take the quetsion time with Zoom suitably.		
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 course objective (B) of Graduate School of Computer Science and Systems Engineering.
		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)	tagami@ces.kyutech.ac.jp		

Course Name(科目名)	Advanced statistical data analysis		
Instructor Name(担当教員名)	Aoi HONDA		
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)	Probability and Statistics grows in importance as a foundation of analyses of experimental data, pattern recognition, machine learning, data mining, image processing, etc. In the course, students first learn the foundation of probability theory, such as the law of large number and the central limit theorem. In the second half, students learn the way of some statistical arguments, such as statistical inference and hypotheses testing. I also explain advanced topics and 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 is one of the basic subjects (elective) for students in the Master's Course. The purpose of this course is to develop the ability to explain logically in papers and oral presentations. The goal is to develop the ability not only to analyze the subject but also to design analytical methods by oneself.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	What is Data Science?	Guidance and descriptive statistics of data
	2.	Multivariate data	Descriptive statistics and visual representation of multivariate data
	3.	Handling of multivariate data	xercises on multivariate data
	4.	Random variables and distributions 1	Distributions of multivariate random variables
	5.	Random variables and distributions 2	Various multidimensional probability distribution functions
	6.	Basic theory of normal distribution and statistical Inference	Multidimensional normal distribution and statistical Inference
	7.	Distributions of multidimensional random variables	Multidimensional conditional probability distributions and descriptive statistics
	8.	Statistical inference of quantitative data for a single population 1	Point estimation and Interval estimation for a single population based on normal distribution
	9.	Statistical inference of quantitative data for a single population 2	Hypothesis testing for a single population Bbased on a normal distribution
	10.	Statistical inference of quantitative data for a single population 3	Hypothesis testing for a single population based on the poisson distribution
	11.	Regression analysis and deep learning	Inference and deep learning based on regression models
	12.	Prediction and control in deep learning	Prediction and control theory for deep learning
	13.	Statistical inference of quantitative data on multiple populations 1	Statistical inference for multiple populations based on normal distribution
	14.	Statistical inference for multiple populations 2	Tests based on contingency tables
	15.	Nonparametric tests	Signed and rank sum tests

General Course Policies(授業の進め方)	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)	Obtain an understanding and practical skills in statistical data science
	Couse objectives (具体的な授業の達成目標)	1. Understand the handling of random variables and the structure of statistics 2. apply basic methods of estimation and testing to real-world problems 3. Understand the relationship between statistical data analysis and artificial intelligence
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)	A small exercise will be assigned each time. A final exam will be given.The final exam will be held at the end of the course, and the grade will be calculated in the ratio of 40% for the exercise and 60% for the exam.	
Assignment Instructions (授業外学習(予習・復習)の指示)	Two hours of preparation per week.	
Keywords(キーワード)	Mathematical Statistics, AI, Machine Learning, Statistical Data Analysis	
Required Textbooks(教科書)	Basics of Statistical Data Analysis, Shu Yamada, Shun Matsuura, Science Inc.(in Japanese)	
References/Recommended Reading(参考書)	Introduce them in class.	
Notes(備考)	None in particular	
Email(電子メールアドレス)	aoi@ces.kyutech.ac.jp	

Course Name(科目名)	Advanced Statistical Machine Learning		
Instructor Name(担当教員名)	TOKUNAGA Terumasa		
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 deal with the basics of data science for estimating an essential and latent structure behind huge datasets in terms of Bayesian inferences and statistical machine learning. At the end of the course, participants are expected to acquire skills to apply basic machine learning techniques including regrression, classification and clustering for real-world problems. In addition, some advanced application studies using deep leraninng, ensemble learning and sequencial estimation based on Bayesian finters will be introduced.		
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 master course students to acquire skills and sences in data science for modeling an latent structure behind huge and complex data.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction	Introduction to machine learning
	2.	Least Squares Method	Understand regression analysis concepts and technique, least squares methods.
	3.	Maximum Likelihood Estimation	Understand regression analysis concepts and technique, maximum likelihood estimation.
	4.	Perceptron Algorithm	Learn the perceptron algorithm which is the most basic method of learning classifier.
	5.	Logistic Regression Analysis	Understand logistic regression analysis.
	6.	Practice: Perceptron Algorithm and Logistic Regression Analysis	Run the codes for Perceptron algorithm and Logistic regression and get the results.
	7.	K-means	Understanding data clustering concepts and techniques (K-means and Hierarchical clustering).
	8.	Practice: K-means	Running clustering in Python with Silhouette distance measure for cluster validity
	9.	EM Algorithm	Understand EM algorithm as one of familiar computational schemes based on the maximum likelihood estimation
	10.	Bayesian Statistics	Understand of the basics of Bayesian statistics.
	11.	Bayesian Regression	Understand Bayesian linear regressions and model averaging.
	12.	Deep Learning with Keras 1	Introduction to Deep Learning & Neural Networks with Keras.
	13.	Deep Learning with Keras 2	Learn the foundations of Deep Learning, understand how to build neural networks.
	14.	Deep Learning with Keras 3	Run the codes for Deep Learning and get the results.
	15.	Deep Learning with Keras 4	Learn the advanced computer vision applications with CNN.

General Course Policies(授業の進め方)		Evaluation is performed comprehensively based on results of exercises or one-minute papers (40%) and submitted reports (60%).
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	Electronically-made lecture materials, such as PowerPoint presentations, will be used.
	Couse objectives (具体的な授業の達成目標)	1. Regression: Minimum square error estimation, Maximum likelihood estimation 2. Classification: Perceptron, Logistic regression, Clustering 3. Validation: Cross-validation, Training error, Generalization error
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		Class attendance, discussion and quizzes (40%). Mid and final reports (60%)
Assignment Instructions (授業外学習(予習・復習)の指示)		Details will be instructed in class
Keywords(キーワード)		Bayeisan inference, statistical machine leanrning
Required Textbooks(教科書)		Details will be instructed in class
References/Recommended Reading(参考書)		・Pattern Recognition and Machine Learning/C.M. Bishop ・ITエンジニアのための機械学習理論入門/中居悦司 ・統計的機械学数理論/金森敬文 ・kerasによるディープラーニング/F. Chollet
Notes(備考)		
Email(電子メールアドレス)		saita@kct.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 take the lectures of this course online. The first class and some of exercises are onsite and they are in synch online. The lecture videos are bloadcasted on Moodle so students watch the videos and solve quiz 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)	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)	Exercises on Advanced Robotics Integration I	
Instructor Name(担当教員名)	Eiji Hayashi, Yuya Nishida, Masahiro Oya	
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) 1
Course Description(授業の概要)	This is practical exercises for advanced robotics integration in "Robotics Synthesis & Management Course". The practical exercise explores proactively future robots' development, the management, the service engineering, focusing on the RaaS (Robot as a Service) with a team to solve the issues for consumers. It consists of a series of lectures and meetings, a parallel series of hands-on lab & trainings. The hand-on trainings will have a plan to lead a robot at factory, hospital, shop, office building and so on with the team base on the consumer's requests and demands. After taking this class, the edge-cloud, the management for the robot will be learned and acquired based on RaaS. The course is helpful intermediate-level programming and software operation skills, management and prior experience in robotics or artificial intelligence but not required.	
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	A series of this consists of "Exercises on Advanced Robotics Integration I, II and III", and then it needs to continuously take all of "Exercise on Advanced Robotics Integration I,II and III" depending on the admission period is in April or October.	
Course Calendar/Class Topic (授業計画)	Theme(テーマ)	Contents(内容)
	1. Understanding robot/AI on RaaS	
	2. Data analysis on robot behavior	
	3. Research for location to introduce robot	
	4. . Plan and Introduction for robot	
	5. Group discussion(1)	
	6. Design robot behavior that facilitate visual landmark-based localization and navigation	
	7. Management plan	
	8. Robot operation plan	
	9. Group discussion(2)	
	10. Hand-on Training (1)	
	11. Hand-on Training (2)	
	12. Hand-on Training (3)	
	13. Group discussion(3)	
	14. Group discussion(4)	
	15. Presentation	
General Course Policies(授業の進め方)	About 5 students will make up a team, and try to mainly do the monthly meeting with Savioke, San Jose, the hand-on lab & training etc..	
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. Team's communication for searching and finding a solution 2. Engineering for taking control of the issues. 3. Sharing information and development for regions and global technologies
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)	Peer review by students (20%), homework, report, and presentation(80%)	
Assignment Instructions (授業外学習(予習・復習)の指示)		
Keywords(キーワード)		
Required Textbooks(教科書)		
References/Recommended Reading(参考書)		
Notes(備考)	Japanese, English	
Email(電子メールアドレス)	Eiji Hayashi haya@mse.kyutech.ac.jp Yuya Nishida y-nishida@brain.kyutech.ac.jp Masahiro Oya oya@cntl.kyutech.ac.jp	

Course Name(科目名)	Exercises on Advanced Robotics Integration Ⅱ		
Instructor Name(担当教員名)	Eiji Hayashi, Yuya Nishida, Masahiro Oya		
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)	1
Course Description(授業の概要)	This is practical exercises for advanced robotics integration in "Robotics Synthesis & Management Course". The practical exercise explores proactively future robots' development, the management, the service engineering, focusing on the RaaS (Robot as a Service) with a team to solve the issues for consumers. It consists of a series of lectures and meetings, a parallel series of hands-on lab & trainings. The hand-on trainings will have a plan to lead a robot at factory, hospital, shop, office building and so on with the team base on the consumer's requests and demands. After taking this class, the edge-cloud, the management for the robot will be learned and acquired based on RaaS. The course is helpful intermediate-level programming and software operation skills, management and prior experience in robotics or artificial intelligence but not required.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	A series of this consists of "Exercises on Advanced Robotics Integration I, II and III", is a prerequisite for taking "Robotics Synthesis & Management Course" and earning "Exercises on Advanced Robotics Integration I". However, if this course's teachers permit to taking this course, this course can be taken without earning "Advanced Robotics Integration I".		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Understanding robot/AI on RaaS	
	2.	Data analysis on robot behavior	
	3.	Research for location to introduce robot	
	4.	Plan and Introduction for robot	
	5.	Group discussion(1)	
	6.	Design robot behavior that facilitate visual landmark-based localization and navigation	
	7.	Management plan	
	8.	Robot operation plan	
	9.	Group discussion(2)	
	10.	Hand-on Training (1)	
	11.	Hand-on Training (2)	
	12.	Hand-on Training (3)	
	13.	Group discussion(3)	
	14.	Group discussion(4)	
	15.	Presentation	
General Course Policies(授業の進め方)	About 5 students will make up a team, and try to mainly do the monthly meeting with Savioke, San Jose, the hand-on lab & training etc..		
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. Team's communication for searching and finding a solution 2. Engineering for taking control of the issues. 3. Sharing information and development for regions and global technologies	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Peer review by students (20%), homework, report, and presentation(80%)		
Assignment Instructions (授業外学習(予習・復習)の指示)			
Keywords(キーワード)			
Required Textbooks(教科書)			
References/Recommended Reading(参考書)			
Notes(備考)	Japanese, English		
Email(電子メールアドレス)	Eiji Hayashi haya@mse.kyutech.ac.jp Yuya Nishida y-nishida@brain.kyutech.ac.jp Masahiro Oya oya@cntl.kyutech.ac.jp		

Course Name（科目名）	Exercises on Advanced Robotics Integration Ⅲ		
Instructor Name(担当教員名）	Eiji Hayashi, Yuya Nishida, Masahiro Oya		
Course intended for（対象学年）	2nd or 3rd year student		
Credit Category（単位区分）	Elective course	Credits（単位数）	1
Course Description（授業の概要）	This is practical exercises for advanced robotics integration in “Robotics Synthesis & Management Course”. The practical exercise explores proactively future robots’ development, the management, the service engineering, focusing on the RaaS (Robot as a Service) with a team to solve the issues for consumers. It consists of a series of lectures and meetings, a parallel series of hands-on lab & trainings. The hand-on trainings will have a plan to lead a robot at factory, hospital, shop, office building and so on with the team base on the consumer’s requests and demands. After taking this class, the edge-cloud, the management for the robot will be learned and acquired based on RaaS. The course is helpful intermediate-level programming and software operation skills, management and prior experience in robotics or artificial intelligence but not required.		
Course and Curriculum linkage （カリキュラムにおけるこの授業の位置付け）	A series of this consists of “Exercises on Advanced Robotics Integration I, II and III”, is a prerequisite for taking “Robotics Synthesis & Management Course” and earning “Exercises on Advanced Robotics Integration I and II ”. However, if this course’s teachers permit to taking this course, this course can be taken without earning ”Advanced Robotics Integration I or II”.		
Course Calendar/Class Topic （授業計画）		Theme(テーマ)	Contents（内容）
	1.	Understanding robot/AI on RaaS	
	2.	Data analysis on robot behavior	
	3.	Research for location to introduce robot	
	4.	Plan and Introduction for robot	
	5.	Group discussion(1)	
	6.	Design robot behavior that facilitate visual landmark-based localization and navigation	
	7.	Management plan	
	8.	Robot operation plan	
	9.	Group discussion(2)	
	10.	Hand-on Training (1)	
	11.	Hand-on Training (2)	
	12.	Hand-on Training (3)	
	13.	Group discussion(3)	
	14.	Group discussion(4)	
	15.	Presentation	
General Course Policies（授業の進め方）	About 5 students will make up a team, and try to mainly do the monthly meeting with Savioke, San Jose, the hand-on		
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. Team’s communication for searching and finding a solution 2. Engineering for taking control of the issues. 3. Sharing information and development for regions and global technologies	
Evaluation Methods and Grading Criteria （成績評価の基準および評価方法）	Peer review by students (20%), homework, report, and presentation(80%)		
Assignment Instructions （授業外学習（予習・復習）の指示）			
Keywords（キーワード）			
Required Textbooks（教科書）			
References/Recommended Reading（参考書）			
Notes（備考）	Japanese, English		
Email（電子メールアドレス）	Eiji Hayashi haya@mse.kyutech.ac.jp Yuya Nishida y-nishida@brain.kyutech.ac.jp Masahiro Oya oya@cntl.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. Furthermore, 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 principle	Principle of virtual work	
	8.	Approximate method based on variational principle	Principle of minimum potential energy	
	9.	Approximate method based on variational principle	Principle of complementary virtual work	
	10.	Approximate method based on variational principle	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. This course will be held online.			
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)	Exercises on Team Management		
Instructor Name(担当教員名)	JAHNG Doosub, ISHII Kazuo, HAYASHI Eiji, OYA Masahiro		
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)	1
Course Description(授業の概要)	Management Project is a project course that is related to AI Robotics in the Robotics Synthesis & Management course. Various perspectives are needed to address issues that are faced by regional Society. In the field of robotics, when considering further development of robots, it is important to embody the technical approach from the viewpoint of utilization and application, service, and management in addition to the acquisition of advanced technology. And then, this project cooperates the educational institutions and companies related to the management, common issues and themes for community benefit are inquired with businessperson, professor, student and so on related to that. And it promotes abilities that are a fusion of the management & the engineer, and the presence in the society. In this course, students will take the initiative in service planning, creating proposals, and practicing management for the coexistence and revitalization of regional societies. In the series of processes. Throughout their hands-on learning experiences, students will practice and learn about team building, activities, and evaluation in order to work as a team.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Robotics Synthesis & Management course is a prerequisite for this course.		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Team Composition,TMC02Management, TMC03Team・TMC04Self-Analysis (SWOT)	
	2.	TMC05Leadership, TMC06Diversity, TMC07SoftSkill	
	3.	TMC08TeamCommunication・ TMC09Planning&HowToSummary	
	4.	TMC10Presentaion, Information transmission, Scheduling management, Evaluation, Marketing, Social investigation method	
	5.	League Match	League Match: Proposal & Preparation (1) : Finally Choosing the proposal which is a high feasibility through the league match
	6.	League Match	Proposal & Preparation (2)
	7.	League Match	Proposal & Preparation (3)
	8.	League Match	League Match: Proposal & Preparation (4)
	9.	Interim report & Presentation	
	10.	League Match (1)	We'll vote on which would be the best proposal
	11.	League Match (2)	
	12.	League Match (3)	
	13.	League Match (4)	
	14.	Preparing final report & presentation	
	15.	Final presentation	
General Course Policies(授業の進め方)	Group Work: The divided 4 teams will proceed with the stages of creating a proposal, obtaining permission, and implementing while receiving consultations based on pre-learning. ・Pre-learning : TM's podcast (DJ Tayori – Anchor, DJ Tayori – Google Podcasts etc.) and the reference materials are provided ・Q&A and discussion b Zoom and so on ・Accountability of learning process upload on KWM (Key Words Meeting) http://www.brain.kyutech.ac.jp/~jahng/wp/?page_id=242		
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. Team's communication for searching and finding a solution 2. Engineering for taking control of the issues. 3. Sharing information and development for regions and global technologies	
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)	Interim presentation (20%)、Final presentation (30%)、Investigation reports (10%)、Final report(40%)		
Assignment Instructions (授業外学習(予習・復習)の指示)			
Keywords(キーワード)			
Required Textbooks(教科書)			
References/Recommended Reading(参考書)			
Notes(備考)	International Student Due to the theme of this course (coexistence and revitalization with regional society), Japanese will be the primarily language used. Please use this opportunity to practice using Japanese. Having a Japanese tutor may be helpful if further support is needed.		
Email(電子メールアドレス)	JAHNG Doosub jahng@brain.kyutech.ac.jp 林　英治 haya@mse.kyutech.ac.jp 石井　和男 ishii@ brain.kyutech.ac.jp 大屋　勝敬 oya@cntl.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 Japanese	
	14.	Oral presentation of English article in Japanese	
	15.	Oral presentation of English article in Japanese	

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)		Preparation and review of the class for four hours per week are needed.
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)		Preparation and review of the class for four hours per week are needed.
Email(電子メールアドレス)		hatakenaka.kiyoshi218@mail.kyutech.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 components 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 principles of MEMS (1)	
	8.	Fundamentals of operation principles of MEMS (2)	
	9.	Examples of MEMS	
	10.	Topics on MEMS devices	
	11.	Physical microsensors	
	12.	Micro actuators	
	13.	Chemiical microsensors	
	14.	Micro chemical systems	
	15.	Summury	

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 and the handouts.	
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）	Micro Fludics		
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 remote presentations and discussions. 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）		
References/Recommended Reading（参考書）		Micro / Nano Thermal Fluid Handbook (NTS Publishing)
Notes（備考）		As a preparatory study, prepare 4 hours a week.
Email（電子メールアドレス）		nagayama@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）	Miniaturization and advanced functionality are evolved about the leading-edge mechanical system such as robotics systems. As the system configuration becomes complicated, extracting a useful parameter out of many parameters, and designing properly is required more and more. In such a curcumstances, development frameworks enables us accelerates development process as it makes us focus on the most important factors among design parameters. Lecture is given about the fundamentals of the HCD (human centered design), KA method, Quality Function Deployment (Quality Function Deployment:QFD) and Robust Quality Engineering: (RQE), which attract attention as an indispensable methods for product development process. In addition, the new machinery based on 3D printer technology is produced increasingly one after another. A lecture is also given about the Additive Manufacturing used as the basis of 3D printer technology. It is given on the history, technology components, the state-of-the-art development trends, and future challenges. Lecture and an exercise are conducted about the following four topics. 1. Design, Product Development, and Research Process 2.Summary and Hardware of 3D Printer 3. 3D Printer-related Software and Algorithm 4. Basic Knowledge on 3D Printer Material		
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.	A design, product development, and a research process	
	2.	HCD (human centered design) and the KA process	
	3.	The way of thinking of a function, and the definition of a function	
	4.	An introduction to QFD (quality functional design)	
	5.	Quality engineering and a parameter design	
	6.	The history and the summary of 3D printer	
	7.	Hardware of 3D printer	
	8.	Basic knowledge on 3D printer material	
	9.	The application example of 3D printer	
	10.	3D printer-related software and an algorithm	
	11.	3D modeling and geometry data processing	
	12.	The geometry processing algorithm relevant to 3D printer	
	13.	3D printer related software	
	14.	Reprap firmware and a temperature control algorithm	
	15.	Reprap firmware and mechanism control algorism	
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. Understand design and product development process, and make your own research plan based on the methods learned. 2. Understand the fundamentals of hardware and software of 3D printer. 3. Understand the basic knowledge of 3D printer materials.	
Evaluation Methods and Grading Criteria （成績評価の基準および評価方法）	Based on the mid term report (20%) and final report (80%)		
Assignment Instructions （授業外学習（予習・復習）の指示）	Prepare homework, 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, Robust 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 4 hours homework per week for preparation and review.		
Email（電子メールアドレス）	nara@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 Controls	introduce to flying robots and wheel chair control
13.	Survey, Consideration, Presentation I	presentation on robot, control, intelligent control, and so on.
14.	Survey, Consideration, Presentation II	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 lecture. In addition, students survey and consider on robot control, and give a presentation. Finally, students create a report on your and others' survey contents. This lecture is taught in Japanese. The lecture materials are mainly given in Japanese. Depending on the infection spread of COVID-19, remote lessons that combines asynchronous and synchronous types may 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)	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）	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.
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

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）		See the moodle course for the detailed information.
Email（電子メールアドレス）		ytetsu@bio.kyutech.ac.jp

Course Name（科目名）	Genetic and Cellular Information (GCI)		
Instructor Name(担当教員名）	Sakae KITADA		
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 based on a lecture format, and aims to connect knowledge and essence of molecular cell biology. It will be provide to dialogue between students as much as possible, extract scientific logic from researchers' experiments and examples of consideration, and use it as the basis for the development of biotechnology. Group discussions on issues, encourage interactive, student communication, and logical scientific expression will be also done in this course.		
Course and Curriculum linkage （カリキュラムにおけるこの授業の位置付け）	It will be expected to understand a part of the molecular and cellular biology in advance. This course is included in a module "System Biology".		

Course Calendar/Class Topic
（授業計画）

		Contents（内容）
1.	Introduction	Lecture
2.	Protein birth, maturation, and related diseases	Lecture
3.	Evolution of cell, construction of eukaryote, and organelle diseases	Lecture
4.	Protein traffic in cell	Lecture
5.	Vesicle traffic in cell, and the related infection	Lecture
6.	Quality control and degradation in cell, and the related diseases	Lecture
7.	Summary of lectures from 2nd to 6th	Lecture
8.	Preparation for group discussion	Organization of lecture and picking up several discussion topics
9.	Group discussion, part1	Discussion in groups of 4 or 5 students
10.	Group discussion, part2	Discussion in groups of 4 or 5 students
11.	Presentation and discussion, part1	Presentation on a theme by students, and discussions
12.	Presentation and discussion, part2	Presentation on a theme by students, and discussions
13.	Presentation and discussion, part3	Presentation on a theme by students, and discussions
14.	Presentation and discussion, part4	Presentation on a theme by students, and discussions
15.	Overall summary	Review and summary of the course so far

General Course Policies（授業の進め方）	Promote basic understanding and problem raising based on the lecture format. From this content, then, problems and issues will be discovered through group discussions. Finally, each student will summarize the research themes and problems found in the discussion and make a presentation. Lecture format (excluding the first day) will be remote, using Moodle, and group discussions and presentations will be held face-to-face.	
Course Objectives （授業の達成目標）	Introduction to Couse Objectives （授業の達成目標の解説）	It will be expected to understand molecular biology in cell, discuss the issues between students, and to improve presentation in scientific fields.
	Couse objectives （具体的な授業の達成目標）	1. Understanding molecular and cellular biology, especially protein maturation, traffic and Quality control. 2. Understanding diseases and infections related above topics. 3. Improving presentation skills in the biological and life science.
Evaluation Methods and Granding Criteria （成績評価の基準および評価方法）	The grade will be determined based on your active discussion (30%) and presentation (70%).	
Assignment Instructions （授業外学習（予習・復習）の指示）	In the subject field studied in the undergraduate school, study the part corresponding to this class.	
Keywords（キーワード）	Gene, transcription, translation, central dogma, protein, folding, organelle, evolution, protein transport, vesicle transport, quality control, proteolysis, cell death, infectious disease, folding disease, organelle disease, amyloid	
Required Textbooks（教科書）		
References/Recommended Reading（参考書）	Molecular Biology of the Cell, 5th edition or later	
Notes（備考）	At least four hours should be spent for preparation per week.	
Email（電子メールアドレス）	kitada@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 medicine
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
8.		
9.		
10.		
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 held as needed. In addition, for each theme, students present what they have learned. In the second half, students explain academic papers written in English. In this class, teachers provide guidance and amendments as needed to encourage lively discussion between students.
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）		4 hr/week
Email（電子メールアドレス）		

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 networks	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)	Remote class (asynchronous)		
Email(電子メールアドレス)	takemoto@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 academic papers.
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)		reserch papar" Cell"
References/Recommended Reading(参考書)		reserch papar" Cell"
Notes(備考)		4 hours a week as a preparatory study.
Email(電子メールアドレス)		aokis@bio.kyutech.ac.jp

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 and the foundamentals of ethology(1)	
	2.	Review for study of behavior and the foundamentals of ethology(2)	
	3.	Review for study of behavior and the foundamentals of ethology(3)	
	4.	Understandig of signal processing in neural systems(1)	
	5.	Understandig of signal processing in neural systems(2)	
	6.	Tail flip escape of the crayfish(1)	
	7.	Tail flip escape of the crayfish(2)	
	8.	Tail flip escape of the crayfish(3)	
	9.	Bending reflex of the leech(1)	
	10.	Bending reflex of the leech(2)	
	11.	Collision avoidance behavior of the pigeon(1)	
	12.	Collision avoidance behavior of the pigeon(2)	
	13.	Collision avoidance behavior of the locust(1)	
	14.	Collision avoidance behavior of the locust(2)	
	15.	Term examination	

General Course Policies（授業の進め方）	This lecture is performed in real time remote lecture by using Zoom system. Powe Point slides are used.	
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 Granding Criteria （成績評価の基準および評価方法）	Evaluations of reports about key wrods in class topics(40%), term examination (60%)	
Assignment Instructions （授業外学習（予習・復習）の指示）	Rports about key words in class topics. 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）	Preparation and review of 4 hours per week	
Email（電子メールアドレス）	naka@bio.kyutech.ac.jp	

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 electroly
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)	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 proteins	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 chemiosmosis	three lectures
	8.		
	9.		
	10.		
	11.		
	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 (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 Granding 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)	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 and Fundamental of spectroscopy	Lecture
2.	Properties of fluorescent proteins	Lecture
3.	Aplications of fluorescent proteins	Lecture
4.	Properties and applications of bioluminescent proteins	Lecture
5.	Fluoresent labeling with tag-probe systems	Lecture
6.	Obsevation of cells by fluorescent microscopy	Lecture
7.	Reading and explanation of references: part 1	Reading and explanation of references
8.	Reading and explanation of references: part 2	Reading and explanation of references
9.	Reading and explanation of references: part 3	Reading and explanation of references
10.	Reading and explanation of references: part 4	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: Topics 1-6: Lecture Topics 7-10: Reading and explanation of references Topics 11-15: Presentation anad discussion 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 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%), mini-examination (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, Sixth edition (Garland Science) Molecular Cloning, Fourth edition (Cold Spring Harbor Laboratory Press) Short Protocols in Protein Science (Wiley)
Notes(備考)		This course will be held online.
Email(電子メールアドレス)		sueda@bio.kyutech.ac.jp

Course Name(科目名)	Electromagnetic Wave Applied Chemistry		
Instructor Name(担当教員名)	Shokichi Ohuchi		
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)	Irradiation of a chemical reaction with microwaves, which is one of the electromagnetic waves, accelerates the reaction. Compared with conventional heating, the reaction time is shortened to 1/100 at the same temperature. Such technologies using microwave energy are attracting attention as energy reduction technologies and low carbon technologies, and play a role in green innovation. In this lecture, in addition to research applying microwave heating to chemical processes, we will explain examples of application to bioprocesses such as cell culture and genetic engineering. The first few lectures will review the organic chemistry and physical chemistry learned in the undergraduate program.		
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 based on the premise that you have taken courses such as organic chemistry, physical chemistry, thermodynamics, physics (electromagnetics), biology, and biotechnology as undergraduate lectures.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1-2.	Chemicals and electromagnetic waves	Various phenomena when irradiating chemical substances with electromagnetic waves
	3-6.	Organic electron theory, thermodynamics	Organic chemistry and thermodynamics under microwave irradiation
	7.	Microwave irradiation effect on organic reaction	cceleration effect of organic chemical reaction under microwave irradiation
	8.	Microwave irradiation effect on enzyme reaction	Acceleration effect of enzyme reaction under microwave irradiation and effect on protein structure
	9-10.	Application to chemical processes, substance separation technology	Chemical process technology and substance separation technology by microwave heating
	11.	Application to bioprocess, sterilization technology	Application of microwave heating to medical technology
	12.	Application to medical technology, hyperthermia	Examples of industrial use of microwave heating technology
	13.	Other microwave energy applied technologies	Thermodynamic quantity calculation of protein by using molecular dynamics
	14.	Laws and regulations and safety of using electromagnetic waves	
	15.	Summary	

General Course Policies(授業の進め方)		Lecture materials will be distributed each time, and lectures will proceed based on it.
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 the phenomena that occur at the molecular level when a chemical substance is irradiated with electromagnetic waves 2. To understand molecular motion, intermolecular interactions, and thermal energy as the basis of microwave chemistry 3. To understand that the use of electromagnetic energy can be used in various industries as an application of microwave chemistry
Evaluation Methods and Grading Criteria (成績評価の基準および評価方法)		This lecture will be evaluated in the final exam.
Assignment Instructions (授業外学習(予習・復習)の指示)		If you cannot understand the content of the lecture within the time of the lecture, you need to try to review it according to your ability. It is important to concentrate on each lecture. Out-of-class learning is left to your own discretion.
Keywords(キーワード)		Microwave Assisted Chemistry, Organic Chemical Reactions, Bioorganic Chemistry, Thermodynamics, Process Chemistry, Green Technology, Biotechnology, Protein Engineering, Omics Technology, Chemical Evolution
Required Textbooks(教科書)		The materials will be handed out.
References/Recommended Reading(参考書)		・ March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 7th ed., Wiley (2013)
Notes(備考)		
Email(電子メールアドレス)		ohuchi@bio.kyutech.ac.jp

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 (It will be an Online Class COVID19.) See Moodle for more informations.			
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 Granding 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)	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. This course will be taught in Japanese. The course materials are mainly given 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)	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)	The materials used in the lecture will be posted on Moodle, so please download and prepare in advance, and bring them with you on the day of the class. After the class, review the material and organize and reconfirm what you have learned. If you have any questions, be sure to ask them or do your own research. Students are expected to set aside 4 hours per week for preparatory study.		
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)	Distance learning courses (both synchronous and asynchronous). Synchronous type is Zoom lectures. The maximum number of remote classes is 15 (face-to-face classes will be conducted according to the situation).		
Email(電子メールアドレス)	arima@cms.kyutech.ac.jp		

Course Name(科目名)	Semiconductor topic seminar		
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 nanotechnol	
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 applications	
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 first check how to take the course. 14 professors give lectures on different themes each time. Therefore, even if you do not register, you can listen to only the topics you are interested in.
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）	Quantitative Biology		
Instructor Name(担当教員名）	Yusuke Morimoto		
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）	Quantitative biology is a general term for methods used to understand life sciences through quantitative analysis of biological phenomena. In this lecture, we will study the basic theory of quantitative biology and introduce various measurement and analysis methods. In addition, the latest research results in related fields will be introduced.		
Course and Curriculum linkage （カリキュラムにおけるこの授業の位置付け）	Since this lecture includes data handling, it is assumed that students will have taken laboratory courses in undergraduate school. A general basic knowledge of physics, biology, and chemistry is desirable, but not required. Related courses include those related to biophysics, biochemistry, and statistics.		

Course Calendar/Class Topic （授業計画）		Theme(テーマ)	Contents（内容）
	1.	Overview	
	2.	Size	
	3.	Concentrations and Absolute Numbers	
	4.	Energies and Forces	
	5.	Rates and Duration	
	6.	Quantitative Measurement of Cells	
	7.	Quantitative Measurement of Multicellular Systems	
	8.	Quantitative Measurement Technology	
	9.	Summary	
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies（授業の進め方）	Mainly lecture style. Exercises to check understanding and interactive discussions will be included. The course may be conducted by remote 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 lecture is to understand the quantitative analysis of physical and chemical quantities that play a role in biological phenomena, and to come into contact with the latest research trends in this field. Specifically, the following items are targeted.
	Couse objectives （具体的な授業の達成目標）	1. Understand the basics of physical and chemical quantities related to biological phenomena 2. Understand measurement methods for quantitative measurement of biological phenomena 3. Understand analytical methods for analyzing measurement data of biological phenomena. 4. Study about the latest research trends in quantitative biology
Evaluation Methods and Granding 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 exercises and final report.	
Assignment Instructions （授業外学習（予習・復習）の指示）	Students are expected to set aside 4 hours per week for preparation. A survey of research trends in the field is recommended.	
Keywords（キーワード）	Quantitative Biology, Biophysics, Statistics, Optogenetics, Fluorescence Imaging	
Required Textbooks（教科書）	No specification.	
References/Recommended Reading（参考書）	細胞の物理生物学 Rob Phillips, Jane Kondev, Julie Theriot 著（共立出版） 数でとらえる細胞生物学　Ron Milo, Rob Phillups 著（羊土社） 定量生物学　小林徹也 編（化学同人）	
Notes（備考）		
Email（電子メールアドレス）	yvm001@bio.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 engineering	
	2.	Methods of user modeling and applications	
	3.	Intelligent Tutoring Systems	
	4.	Intelligent Tutoring Systems	
	5.	Recommender Systems	
	6.	Midterm report	
	7.	Programming	
	8.	Programming	
	9.	Programming	
	10.	Programming	
	11.	Programming	
	12.	Programming	
	13.	Writing a report	
	14.	Writing a report	
	15.	Reviewing other reports	

General Course Policies(授業の進め方)		Lectures and exercises will be done asynchronously (15 lectures in total). Attendance will be counted if you watch all the videos and report your progress by the deadline. Instead of a final exam, you need to submit a report and questions/comments on other reports.
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 Granding 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)		Any changes will be announced on moodle.
Email(電子メールアドレス)		kunitika@ai.kyutech.ac.jp

Course Name(科目名)	High Reliability Design		
Instructor Name(担当教員名)	WEN Xiaoqing		
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 genetation, and design for testability.		
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. 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 Arichitecture", "Logic Design", "Integrated System Design", and "Integrated System Design Exercise" 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.	Built-In Self-Test	
	11.	Test Compression	
	12.	Low-Power Test I	
	13.	Low-Power Test II	
	14.	Summary	
	15.	Final Exam	
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 your homework report several times. In addition, mid-term and final exams will be conducted. This first half of the course will be taught in English and the second half of the course will be taught in Japanese. 20% of the course materials are given in Japanese and 80% of the course materials are 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)	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)	
Evaluation Methods and Granding 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 lecturers in advance (wen@cse.kyutech.ac.jp, holst@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 Elsevier.		
Notes(備考)	Remote course with Zoom		
Email(電子メールアドレス)	Xiaoqing Wen (wen@cse.kyutech.ac.jp), Stefan Holst (holst@cse.kyutech.ac.jp)		

Course Name(科目名)	Mechanism and Kinematics		
Instructor Name(担当教員名)	Takahiro ITO		
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 will take up a wide range of mechanisms from robots, vehicles to micro electro mechanical systems, and explain their mechanisms and movements.		
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	Since we are assuming mechanical design, manufacturing, and measurement technology, which are mainly represented by mechatronics and MEMS technology, students are supposed to have taken specialized courses related to mechanical and electronic design, manufacturing, and measurement technology. Alternatively, preparation for basic knowledge equivalent to the above is a prerequisite. Therefore, it is a prerequisite to take the following undergraduate lectures. "Information and communication network" (computer, semiconductor manufacturing) "Information and communication network training" (network technology) "Basic control II" (modeling and design of controlled objects),		
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction to Mechatronics	
	2.	Introduction to Vibration Studies	
	3.	Basic knowledge of vehicle engineering	
	4.	High-speed rail bogie design	
	5.	Car movement and design	
	6.	Railroad and mechatronics	
	7.	Railroad model mechatronics	
	8.	Introduction to micromachines	
	9.	Mico mechanisms	
	10.	Introduction to MEMS	
	11.	MEMS manufacturing process	
	12.	MEMS design method	
	13.	Optical MEMS	
	14.	Mechatronics / MEMS Technical Exercise	
	15.	Latest trends from international conferences and conference presentations	
General Course Policies(授業の進め方)	Perform in a seminar format using a textbook. Exercises such as discussions will be held as appropriate to deepen understanding between lectures.		
Course Objectives (授業の達成目標)	Introduction to Couse Objectives (授業の達成目標の解説)	In relation to learning and education goals, students will acquire the common item (B), the information system major, the technical development of (1) (2) (3) in the field of mechanical information engineering, and the system evaluation technology for system construction. The following items are the goals to be achieved.	
	Couse objectives (具体的な授業の達成目標)	1. Understanding mechatronics and micromachines 2. Understand the mechanism and vibration phenomenon. 3. Can make research plans for mechatronics and MEMS.	
Evaluation Methods and Granding Criteria (成績評価の基準および評価方法)	Attendance and submission of reports are mandatory, and the degree of achievement of the achievement goals will be evaluated based on the degree of understanding of the part in charge of the seminar, explanation contents, prepared materials, questions and answers, homework, and reports.		
Assignment Instructions (授業外学習(予習・復習)の指示)	We will give instructions as appropriate, so be proactive.		
Keywords(キーワード)	Micromechanisms, MEMS		
Required Textbooks(教科書)	"Mechanism and Kinematics," written by Teru Hayashi and Takahiro Ito, Corona-shya (In Japanese), ISBN978-4-339-04596-3		
References/Recommended Reading(参考書)	"Optical MEMS," written by Renshi Sawada, Kazuhiro Hane, and Eiji Higurashi, Ohm-shya (In Japanese), ISBN 978-4-274-03589-0		
Notes(備考)			
Email(電子メールアドレス)	ito@mse.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 computer graphics and OpenGL programming are not mandatory but desirable.		
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 Programming	
	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 Models	
	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)	The class materials such as lecture videos and exercises will be available before class. During class. The questions about the lectures and programming exercises will be answered during class. The students will be required to work on programming exercises and submit reports after class.		
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 are as follows,	
	Couse objectives (具体的な授業の達成目標)	1. To learn advanced techniques on computer graphics and be able to apply them for application software 2. 3.	
Evaluation Methods and Granding 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-clss and post-class study.		
Email(電子メールアドレス)	oshita@ces.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.		
9.		
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 develop whole phase locked loop (PLL) and perform whole simulation.	
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 Granding 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)	System Architecture			
Instructor Name(担当教員名)	YOSHISDA Takaichi			
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 basic concepts of software architecture and distributed system architecture as a case examples of system architecture.			
Course and Curriculum linkage (カリキュラムにおけるこの授業の位置付け)	You are required to have learned courses related to software engineering, operating systems, and computer networks.			
Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)	
	1.	Introduction		
	2.	Overview of Software Architecture		
	3.	Quality Attributes		
	4.	Architectural Pattern		
	5.	Designing the Architecture		
	6.	Documenting Software Architectures		
	7.	Analyzing Architectures		
	8.	Software Product Lines		
	9.	Introduction to Distributed Systems		
	10.	Design Issues		
	11.	Inter Process Communication and Remote Method Invocation		
	12.	Distributed File Systems and Naming		
	13.	Concurrency Control		
	14.	Reliability		
	15.	Security		
General Course Policies(授業の進め方)	Lectures will be given according to the materials distributed in advance. To understand actual examples of software architecture and distributed system architecture, a case study homework will be assigned. 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)	The goals of this course are to understand		
	Couse objectives (具体的な授業の達成目標)	1. Design, analysis and documentation of software architecture. 2. Architecture of distributed systems. 3. Issues and solutions of distributed computing.		
Evaluation Methods and Granding Criteria (成績評価の基準および評価方法)	Your overall grade in this course will be decided based on mid-term repot (Case study on software architecture design: 50%) and final report (Case study on distributed middleware: 50%)			
Assignment Instructions (授業外学習(予習・復習)の指示)	Read the course material in detail. If you have any point you cannot understand, study the point before each lecture. You are required to take four hours a week for preparation.			
Keywords(キーワード)	Functionality and Quality Attributes, Design Pattern, Software Life Cycle, Network Transparency, Transaction Processing			
Required Textbooks(教科書)				
References/Recommended Reading(参考書)	Software Architecture in Practice, Second Edition, Len Bass, Paul Clements, Rick Kazman, Addison Wesley, 2003. Engineering Distributed Objects, Wolfgang Emmerich, John Wiley & Sons, 2000. Distributed Systems, Principles and Paradigms, Second Edition, Andrew S. Tanenbaum, Maarten Van Steen, Persons Education, 2007.			
Notes(備考)	This cource will be taught in Japanese. However, all of the course materials are in English.			
Email(電子メールアドレス)	takaichi@ai.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.	Engineer Education	
	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 addition, it gives the exercise appropriately. Lecture videos and exercises are provided on the moodle. And the questions about lectures and exercises are replied on line. This course will be taught in Japanese. The course materials are mainly given 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)	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 development process. 2. understand the basic contents of modeling technology and re-engineering technology to solve problems by applying information systems. 3. understand the basic contents of the system structure and project management to develop an information system.	
Evaluation Methods and Granding 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)	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.	Engineer Education		
	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 addition, it gives the exercise appropriately. Lecture videos and exercises are provided on the moodle. And the questions about lectures and exercises are replied on line. This course will be taught in Japanese. The course materials are mainly given 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)	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 development process. 2. understand the basic contents of modeling technology and re-engineering technology to solve problems by applying information systems. 3. understand the basic contents of the system structure and project management to develop an information system.		
Evaluation Methods and Granding 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)		Lectures and assignments. Lecture materials and assignments are provided on the moodle. And it replies questions about them on line. This course will be taught in Japanese. The course materials are mainly given 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)	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 works and how to make a project plan. 3. understand the concepts of the TOC and Critical Chain Project Management.
Evaluation Methods and Granding Criteria (成績評価の基準および評価方法)		Evaluate based on the contents of the reports and the exercise products.
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)	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 and applications	
3.	Intelligent Tutoring Systems	
4.	Intelligent Tutoring Systems	
5.	Recommender Systems	
6.	Midterm report	
7.	Programming	
8.	Programming	
9.	Programming	
10.	Programming	
11.	Programming	
12.	Programming	
13.	Writing a report	
14.	Writing a report	
15.	Reviewing other reports	

General Course Policies(授業の進め方)		Lectures and exercises will be done asynchronously (15 lectures in total). Attendance will be counted if you watch all the videos and report your progress by the deadline. Instead of a final exam, you need to submit a report and questions/comments on other reports.
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 Granding 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)		Any changes will be announced on moodle.
Email(電子メールアドレス)		kunitika@ai.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.	Processor of languages for numerical computation	
	3.	Data type and format for numerical computation	
	4.	Error evaluation in numerical computation	
	5.	Matrix computation (1)	
	6.	Matrix computation (2)	
	7.	Computation for polynomials	
	8.	Numerical computation for ODE	
	9.	Simulation of control systems	
	10.	Simulation based on block diagrams	
	11.	Introduction to embedded system	
	12.	Periodic execution of real-time tasks	
	13.	Implementation of real-time control systems	
	14.	Numerical computation in next-generation	
	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 Granding 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)	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.	Mehod for System analysis	
	5.	Mehod for System design	
	6.	No SQL	
	7.	Basic technologies for WEB application 1	
	8.	Basic technologies for WEB application 2	
	9.	Methods for Software testing1	
	10.	Methods for Software testing2	
	11.	Infrustructure for Cloud computing	
	12.	PBL 1	
	13.	PBL 2	
	14.	PBL 3	
	15.	Presentation for Results of PBL	
General Course Policies(授業の進め方)	The class will be adovanced on the above course calender with PBL style, in which each topic is discussed by a small gourp of students and teachers.		
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 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 (1)	Implementing a system call in Linux (1)
7.	Creating a system call (2)	Implementing a system call in Linux (2)
8.	Desktop virtualization	Providing the overview of desktop virtualization
9.	Linux kernel modules	Providing the internals of Linux kernel modules
10.	Creating a kernel module (1)	Implementing a Linux kernel module (1)
11.	Creating a kernel module (2)	Implementing a Linux kernel module (2)
12.	Filesystem and FUSE	Providing the internals of filesystems and the FUSE library
13.	Creating a filesystem	Implementing a filesystem using FUSE
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 Granding 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@ksl.ci.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)	More than 60 years have passed since the invention of LSI (Large Scale Integrated Circuits), and the miniaturization of LSI devices is reaching its physical and economic limits. What we need to learn about this LSI technology now is the successful experience of LSI-specific manufacturing and design methods that have continued to improve its performance over the past 60 years. It is also important to understand the development of LSI and semiconductor device technologies in the new era beyond the limits. In this class, the trend of LSI device miniaturization for higher performance and lower cost will be explained. Then, the challenges of device miniaturization and the current situation where the limits are being reached will be introduced. Then, efforts to improve the performance of new LSIs and semiconductor devices will be introduced. In addition, innovations in LSIs and semiconductor devices will be introduced in order to understand value creation.		
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	Outline and aims of the lecture, schedule, grading method, etc.
	2.	LSI manufacturing technology	Characteristics of LSI structure and manufacturing methods
	3.	LSI element miniaturization	Device miniaturization and its effects on LSI value
	4.	Limitations of LSI device miniaturization	LSI device miniaturization trend, its limitations and approaches
	5.	LSI design technology	Overview and key points of LSI design methodology
	6.	Large-scale LSI design	Development of design tools (CAE) for complex and large-scale LSI design
	7.	Deployment example of new type LSI	New value-added LSI and semiconductor devices
	8.	Development environment for new technologies	The technological environment required for new LSIs and devices
	9.	Objectives and outline of the exercises, Exercise 1	Consideration of latent needs in innovation examples
	10.	Introduction of development case (1)	Neural Network LSI with On-Chip Learning Function
	11.	Introduction of development case (2)	Image sensor that mimics the auto-adjustment of local sensitivity in vision
	12.	Exercise 2	Discovering latent needs and examining the lifestyle changes that result from solving them
	13.	Introduction of development case (3)	Real-time 3D range sensor LSI
	14.	Introduction of development case (4)	Lensless near infrared sensor device
	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. This course will be taught in Japanese. The course materials are mainly given 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)	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)	The materials used in the lecture will be posted on Moodle, so please download and prepare in advance, and bring them with you on the day of the class. After the class, review the material and organize and reconfirm what you have learned. If you have any questions, be sure to ask them or do your own research. Students are expected to set aside 4 hours per week for preparatory study.		
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)	Distance learning courses (both synchronous and asynchronous). Synchronous type is Zoom lectures. The maximum number of remote classes is 15 (face-to-face classes will be conducted according to the situation).		
Email(電子メールアドレス)	arima@cms.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", "Computer System II", "Computer Architecture", "Programing", "Data base and algorithm" have been taken.		

Course Calendar/Class Topic (授業計画)		Theme(テーマ)	Contents(内容)
	1.	Introduction of LSI design	
	2.	Transistor, CMOS	
	3.	LSI design flow	
	4.	Overview of frontend design	
	5.	Verification	
	6.	Logic synthesis	
	7.	Design for test	
	8.	Layout design	
	9.	Logic simulation	
	10.	Understanding circuit description	
	11.	Power analysis	
	12.	Conclusions	
	13.		
	14.		
	15.		

General Course Policies(授業の進め方)		This course takes lecture style. (on-demand 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 Granding 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)		This course takes on-demand style. QandA will be done with Zoom if needed.
Email(電子メールアドレス)		k_miyase@cse.kyutech.ac.jp

Course Name（科目名）	Japanese Ⅰ		
Instructor Name(担当教員名）	HIRATA Yuko		
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）	Based on Japanese social and cultural topics, students will improve their reading and listening skills, expand their vocabulary, and develop the ability to express their thoughts and feelings appropriately.		
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 basic course for international students and is designed to establish intermediate level Japanese language skills for supporting university life. It is assumed that students have at least beginner/intermediate Japanese language ability (about JLPT test N3 level).		

Course Calendar/Class Topic
（授業計画）

	Theme(テーマ)	Contents（内容）
1.	Lesson 1: The Ichiroku Bank	″tame″ to express a reason
2.	Lesson 1: The Ichiroku Bank	Supporting the partner's decision
3.	Lesson 2: Zoo	The result of the operation: ″～ta tokoro″
4.	Lesson 2: Zoo	Expressing a result that is contrary to expectations
5.	Lesson 3: Virtual Reality	Onomatopoeia and mimetic words
6.	Lesson 3: Virtual Reality	Expressing that facts differ from appearances
7.	Lesson 4: Body Time	Partial negative expressions
8.	Lesson 4: Body Time	Passive affirmation
9.	Lesson 5: Nature	Double negative expressions
10.	Lesson 5: Nature	Emphasis
11.	Lesson 6: Left-handedness	The result of reminiscence: ″～mono da″
12.	Lesson 6: Left-handedness	Speaking nostalgically and with emotion
13.	Lesson 7: Symbiotic Housing	Evidence: ″～ijo″
14.	Lesson 7: Symbiotic Housing	Expressing the speaker's determination and resolve
15.	″VOICES FROM JAPAN″	Discussion
16.	Summary and examination	

General Course Policies（授業の進め方）	While studying each lesson, students will confirm sentence patterns, grammar, vocabulary, and expressions, and deepen their understanding of the content. After close reading, we will exchange opinions on each topic. In addition, vocabulary and sentence patterns will be reinforced through assignments. Mid-term and final exams will be given 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）	Students will develop intermediate level expression skills to support their university life. Students will be able to express their knowledge and thoughts on each topic in their own words.
	Couse objectives （具体的な授業の達成目標）	1. To improve reading and listening skills 2. To expand vocabulary on social and cultural topics 3. To express one's thoughts accurately in Japanese
Evaluation Methods and Ganding Criteria （成績評価の基準および評価方法）	Evaluation will be based on class participation (20%), assignments (20%), and mid-term and final examinations (60%).	
Assignment Instructions （授業外学習（予習・復習）の指示）	Students are expected to set aside 30 minutes per week for study preparation. Students are required to submit assignments for each lesson.	
Keywords（キーワード）	Japanese society and culture, reading comprehension, vocabulary, expression.	
Required Textbooks（教科書）	NobukoMizutani: Modern Japanese Intermediate Cours, Alc Publishing. Yuriko Nagata: VOICES FROM JAPAN, Kuroshio Publishing Co.	
References/Recommended Reading（参考書）		
Notes（備考）		
Email（電子メールアドレス）	jayjammin.chiro.haru56@gmail.com	

Course Name(科目名)	Diversity, Inclusion, and Equity			
Instructor Name(担当教員名)	KATO, Reiko			
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)	In the globalized society, we can find conflicting discourses on "Multiculturalism": exclusion and inclusion of human diversities in communities. However, acceptance of different cultures has become a key competence to contribute to the sustainable development of the global society. In this course, we will examine diversities in our society, and will critically look at issues and initiatives regarding multiculturalism in our daily lives. We will then make suggestions/proposals to make our society more inclusive and equitable. Through classroom discussions and group activities, the course will offer opportunities to strengthen critical thinking, problem solving, and intercultural communication skills.			
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 part of the Advanced Global Liberal Arts Subject, an elective course for the Global Engineer Course.			

Course Calendar/Class Topic
(授業計画)

	Theme(テーマ)	Contents(内容)
1.	Global Trend of Multiculturalism in the 21st Century	Introduction to the Course and the concept of Multiculturalism
2.	Diversity in local communities	Examining the Effects of Globalization and Diversification in local communities
3.	Diversity in classrooms	Examining the Effects of Globalization and Diversification in Education Sectors.
4.	Diversity in workplaces	Examining the Effects of Globalization and Diversification in Workplaces
5.	Mechanism of Prejudice and Intervention	Rethinking "prejudice" and "intervention" from cultural perspective
6.	Promoting Multiculturalism: Proposal to our community 1	Gathering and analyzing current issues on multiculturalism and identifying a problem to take on as your group project
7.	Promoting Multiculturalism: Proposal to our community 2	Group Discussion on Proposal to our Community.
8.	Group Presentations and Conclusion	Peer review for classmates proposals
9.		
10.		
11.		
12.		
13.		
14.		
15.		

General Course Policies(授業の進め方)		All class meetings will be held online on Zoom. The Zoom access will be announced via Course Moodle. After each class meeting, participants need to submit a reflective memo on Moodle. Reflective memos will be used to confirm attendance to the class. The Final Project includes a group presentation and an individual report. In this course, "Active Learning Strategies" will be implemented. Active Learning Strategies help learners to engage in activities based on ideas about how people learn. –Through experiences: Do it –Through discussions: Talk about it with others –Through rephrasing: Say it in your words –Through investigations: Clarify it –Through reflection: Know what you have learned Active and informed participation in class results from your preparation and reflection of the course materials. If you have an unavoidable reason to be absent or tardy (such as sickness, family emergency, religious holidays, or job interviews), consult with your instructor in advance. This course will be conducted in Japanese. Slides/Reading materials are available 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)	By scrutinizing Issues and Initiatives regarding Multiculturalism, this course aims to foster Global Competence of participants. At the end of this course, the participants will be able to gain knowledge/improve their skills in following aspects.
	Couse objectives (具体的な授業の達成目標)	1. Explain issues of Multiculturalism with concrete examples. 2. Identify initiatives to construct inclusive society with concrete examples. 3. Suggest ideas to make society more inclusive and equitable. 4. Work in a multicultural group using effective intercultural communication skills.
Evaluation Methods and Ganding Criteria (成績評価の基準および評価方法)		In-class contributions (50%) and Group Project (50%)
Assignment Instructions (授業外学習(予習・復習)の指示)		There will be reading assignments on Moodle for each class meeting. Also, participants were expected to have group meetings for the project. For preparation and group meetings, participants were expected to spend around 2 hours/week.
Keywords(キーワード)		Human Rights, Prejudice, Multiculturalism, Reasonable Accommodation, Intercultural Communication Competence
Required Textbooks(教科書)		There are no required Textbooks, but articles for discussion will be distributed and references will be introduced in class.

References/Recommended Reading(参考書)	Aramaki, S., Enoi,Y., Ehara, H., Kojima, Y., Shimizu, K., Minamino, N., Miyajima, T., & Yamano, R. (Eds.). (2017). Gaikokujin no kodomo hakusho [The state of the foreign children]. Tokyo: Akashishoten. ISBN 9784750344959 Koido, A. (Ed.). (2017). Imin ukeire no kokusai shakaigaku: senbetsu mekanizumu no hikaku bunseki [International Sociology of Immigration Acceptance: Comparative Analysis of Selection Mechanism]. The University of Nagoya Press. ISBN 9784815808679 Koizumi, K and Kawamura, C. (Eds.). (2016). Tabunka "kyo¯so¯" shakai nyu¯mon: imin, nanmin to tomo ni kurasu tagai ni manabu shakai e [Multicultural synergy : conceptual challenges and practical solutions in the age of global migration]. Keiō Gijuku Daigaku Shuppankai. ISBN 9784766423716 Menju, T. (2016). Jichitai ga hiraku nihon no imin seisaku: jinko¯ gensho¯ jidai no tabunka kyo¯sei e no cho¯s [Local Governments Lead Japan's Immigration Policy : Challenge for multicultural symbiosis in the era of population decline]. Akashishoten. ISBN 9784750343655 Kagami, T. (Ed.). (2013) Tabunka kyo¯sei ron: tayo¯sei rikai no tame no hinto to ressun [Multicultural existence theory: Hints and lessons for understanding diversity]. Akashishoten. ISBN 9784750338484 Kagami, T. (Ed.). (2012) Tabunka shakai no henken, sabetsu : keisei no mekanizumu to teigen no tame no kyoiku [Bias/discrimination in multicultural societies: The formation mechanism and education for prejudice reduction] Akashishoten. ISBN 9784750335810 References in English will be provided in class
Notes(備考)	Office hours will be announced in the first class meeting.
Email(電子メールアドレス)	kato@lai.kyutech.ac.jp

Course Name（科目名）	Information Society		
Instructor Name(担当教員名)	Keiko Yasukochi		
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）	1
Course Description（授業の概要）	The rapid development of information technology since 1970 has greatly advanced informatization and globalization all over the world. Exponential developing information technology has promoted online platform companies (such as GAFAM), changed emoloyments, and may bring singularity around 2045. In this course, lectures are given about history of development of information technology, the problems of online platform companies, the future of employment, and the singularity. Furthermore, we consider the future and issues of information society.		
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 an advanced globa liberal arts subject in the Global Engineering Course. This course places to learn the current states of information sosiety, and make students think about the future and issues of information society.		

Course Calendar/Class Topic （授業計画）		Theme(テーマ)	Contents（内容）
	1.	Introduction: Development of information technology and future of humankind, society	
	2.	Development of information technology and chnges of society	
	3.	Rise and problems of online platform companies	
	4.	Development of information technology and future of employment	
	5.	Singularity and future of humankind	
	6.	Singularity and 2045issue	
	7.	Last: Development of information technology and future of humankind, society	
	8.	Summary and explanation about final exam (final report)	
	9.		
	10.		
	11.		
	12.		
	13.		
	14.		
	15.		

General Course Policies（授業の進め方）		The first harf of this class carries out in lecture style, and the latter harf in seminar style (if possible).	
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 make students learn the current states of information sosiety, and think about the future and issues of information society.	
	Couse objectives （具体的な授業の達成目標）	1. Understand the history of progress of computerization	
		2. Understand the current situation and issues of information society	
		3. Understand the problemsn and issues that will arive in the future information society	
Evaluation Methods and Ganding Criteria （成績評価の基準および評価方法）		Your overall grade in this class will be decided based on following: -Small reports (50%) (in total) -Final exam (or Final report) (50%)	
Assignment Instructions （授業外学習（予習・復習）の指示）		This class requires for 2-4hours per week, and 8-10hours at last time. (1) On every lesson: preparations / reviews is essencia l: Gathering informations and writing small report (about 2hours) (2) On presentation: Getting ready for presentation (about 4hours) (3) On Final exam (or Final report) : Reviewing all the contents you have learned so far (about 8-10hours)	
Keywords（キーワード）		Informatization, Information Society, Online Platform Compnies, GAFAM, Future of Employment, Singularity, 2045issue, Universa Basic Incom, Dr.Osborne, Dr.Kurtzweil	
Required Textbooks（教科書）		None	
References/Recommended Reading（参考書）		レイ・カーツワイル『ポストヒューマン誕生 -コンピュータが人類の知能を超えるとき-』（NHK出版） レイ・カーツワイル『シンギュラリティは近い』（NHK出版編集）（NHK出版）	
Notes（備考）		(1) At first class, I explain overall process of this course. (2) If you have any questions, please send me an email (email adress is below).	
Email（電子メールアドレス）		yasukochi@lai.kyutech.ac.jp	