科目コード (Code)	科目名 (Course title)	Course title (English)
10G001	応用数値計算法	Applied Numerical Methods
10G003	固体力学特論	Solid Mechanics, Adv.
10G005	熱物理工学	Thermal Science and Engineering
10G007	基盤流体力学	Introduction to Advanced Fluid Dynamics
10G009	量子物性物理学	Quantum Condensed Matter Physics
10G011	設計生産論	Design and Manufacturing Engineering
10G013	動的システム制御論	Dynamic Systems Control Theory
10G057	技術者倫理と技術経営	Engineering Ethics and Management of Technology
10G017	破壊力学	Fracture Mechanics
10B628	中性子物理工学	Neutron Physical Technology
10B407	ロボティクス	Robotics
10G025	メカ機能デバイス工学	Mechanical Functional Device Engineering
10G036	機械理工学基礎セミナーA	Basic Seminar on Mechanical Engineering and Science A
10G037	機械理工学基礎セミナーB	Basic Seminar on Mechanical Engineering and Science B
10G041	有限要素法特論	Advanced Finite Element Method
10B418	先進材料強度論	Strength of Advanced Materials
10B622	熱物性論	Thermophysics for Thermal Engineering
10G039	熱物質移動論	Transport Phenomena
10G021	光物理工学	Engineering Optics and Spectroscopy
10G403	最適システム設計論	Optimum System Design Engineering
10B631	高エネルギー材料工学	High Energy Radiation Effects in Solid
10B634	先端物理工学実験法	Advanced Experimental Techniques and Analysisin Engineering Physics
10Q807	デザインシステム学	Theory for Design Systems Engineering
10V003	バイオメカニクス	Biomechanics
10W603	医工学基礎	Introduction to Biomedical Engineering
10Q402	乱流力学	Turbulence Dynamics
10Q610	原子系の動力学セミナー	Seminar: Dynamics of Atomic Systems
10V007	中性子材料工学セミナーⅠ	Neutron Science Seminar I
10V008	中性子材料工学セミナーⅡ	Neutron Science Seminar II
10i056	現代科学技術特論（8回コース）	Advanced Modern Science and Technology(8 times course)
10X411	複雑系機械システムのデザイン	Design of Complex Mechanical Systems
10X402	アーティファクトデザイン論	Theory for Designing Artifacts
10G055	金属結晶学	Crystallography of Metals
10G061	応用数理科学	Applied mathematical sciences
693517	統合動的システム論	Theory of Integrated Dynaminal Systems
693513	ヒューマン・マシンシステム論	Theory of Human-Machine Systems
693431	力学系理論特論	Dynamical Systems, Advanced
653316	熱機関学	Heat Engine Systems
653322	燃焼理工学	Combustion Science and Engineering
88G101	研究倫理・研究公正（理工系）	Research Ethics and Integrity(Scienceand Technology)
88G104	知的財産	Intellectual Property
10G049	インターンシップM（機械工学群）	Engineering Internship M
10G051	機械理工学特別実験及び演習第一	Experiments on Mechanical Engineering and Science,Adv. I
10G053	機械理工学特別実験及び演習第二	Experiments on Mechanical Engineering and Science,Adv. II
10G058	複雑系機械工学基礎セミナー１	Basic Seminar of Complex Mechanical Engineering,1
10G059	複雑系機械工学基礎セミナー２	Basic Seminar of Complex Mechanical Engineering,2

未更新

Numbering code			
Course title <English>	応用数値計算法 Applied Numerical Methods	Affiliated department, Job title,Name	Graduate School of Engineering Professor,INOUE YASUHIRO Graduate School of Engineering Associate Professor,TSUCHIYA TOSHIYUKI

Target year		Number of credits	2	Course offered year/period	2019/First semester

Day/period	Mon.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Numerical techniques, such as the finite element method and numerical control method, are indispensable in mechanical engineering. In this lecture, basics of numerical techniques which are required to study advanced methods for graduated students will be explained. The lecture will cover the linear system solution (Ax=b), eigenvalue analysis, interpolation approximation method, solutions of ordinary differential equation and partial differential equation. The programing exercise is included in this lecture.

[Course Goals]

Understandings of mathematical theories and programing implementations of the numerical methods.

[Course Schedule and Contents]

Introduction,1time,Introduction of this class\\Numerical representations and errors\\Macro programing using spread sheet applications
Linear system,1time,Matrix\\Norms\\Singular value decomposition
Linear simultaneous equation 1,2times,Solution of simultaneous linear equations\\direct method, iteration method
Eigenvalue analysis,2times,Eigenvalue problems
Interpolation ,2times,Interpolation and its errors
Numerical integra l ,2times,Numerical integration methods
Normal differential equation and numerical integral,1time,explicit method, implicit method\\ initial value problem, boundary value problem
Partial differential equation,3times,Differential expression of partial differential\\ Diffusion equation, wave equation\\Poisson equation, Laplace equation
Examination,1time,Feedback for homework and examination

[Class requirement]

Basic mathematics for undergraduates
Basic macro programing

[Method, Point of view, and Attainment levels of Evaluation]

Home works (four home works will be assigned) and examination.

Continue to 応用数値計算法(2)↓↓↓

応用数値計算法(2)

[Textbook]

Lecture note will be distributed through the course website.

[Reference books, etc.]

（Reference books）

Golub, G. H. and Loan, C. F. V., Matrix Computations, John Hopkins University Press\R.D.Richtmyer and K. W.Morton, Difference Methods for Initial-Value Problems, Second Edition, John Wiley amp Sons 1967

（Related URLs）

(Lecture notes, home works, and other info will be distributed through PandA: https://panda.ecs.kyoto-u.ac.jp)

[Regarding studies out of class (preparation and review)]

Problems are based on macro on Microsoft Excel or LibreOffice.

（Others (office hour, etc.)）

Have a PC with Microsoft Excel with VBA or LibreOffice (https://ja.libreoffice.org/).

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	固体力学特論 Solid Mechanics, Adv.	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI Graduate School of Engineering Associate Professor,SHIMADA TAKAHIRO

Target year		Number of credits	2	Course offered year/period	2019/First semester

Day/period	Thu.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

This course provides fundamental concepts of solid mechanics such as stress, strain, and constitutive laws, and methods for analyzing stress/strain fields and deformation of solids and structures on the basis of the concepts. In particular, the course lectures theories of nonlinear problems such as plasticity and creep, and their numerical solutions, or finite element methods, which are important for design and development of mechanical structures.

[Course Goals]

Students will be able to:
understand solid mechanics deeply and acquire basic knowledge to design mechanical structures.
analyze problems of plasticity and creep by finite element methods.

[Course Schedule and Contents]

Introduction,1time,Overview of solid mechanics
Stress,1time,Cauchy stress tensor, Equilibrium equation, Invariants
Deformation,2times,Material description and spatial description, Displacement, Deformation gradient, Lagrange-Green strain and Euler-Almansi strain, Infinitesimal strain, Material time derivative
Constitutive equation: linear elasticity,1time,Linear elastic stress-strain response, Hookersquos law
Principle of virtual work and principle of minimum potential energy,1time,Principle of virtual work, Principle of minimum potential energy
Finite element method for linear elasticity,3times,Basis of finite element method, Finite element equilibrium equations, Elements, Numerical integration
Plasticity problems,3times,Plasticity theory (uniaxial and multiaxial problems, yield criteria, flow rule, hardening rule, constitutive equations), Finite element method for elasto-plastic problems
Creep problems,2times,Creep theory (uniaxial and multiaxial constitutive equations), Finite element method for creep problems
Summary,1time,Discussions and reports
Feedback,1time

[Class requirement]

This course requires basic knowledge of mechanics of materials and solid mechanics.

[Method, Point of view, and Attainment levels of Evaluation]

Grading is based on the examination, possibly with considerations of the homework reports.

[Textbook]

Lecture materials are distributed in the classroom.

Continue to 固体力学特論(2)↓↓↓

固体力学特論(2)

[Reference books, etc.]

（Reference books）

T. Kyoya, Continuum Mechanics, Morikita (2008) (in Japanese)\ Y. Tomita, ldquoFoundation and Application of Elastoplasticityrdquo Morikita (1995) (in Japanese)\ E. Neto et al., ldquoComputational Methods for Plasticity,rdquo John Wiley amp Sons (2008).

[Regarding studies out of class (preparation and review)]

Preparation and review of lecture materials. Exercises.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	熱物理工学 Thermal Science and Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,YOSHIDA HIDEO Graduate School of Engineering Associate Professor,MATSUMOTO MITSUHIRO

Target year		Number of credits	2	Course offered year/period	2019/First semester

Day/period	Mon.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Several topics in advanced thermal physics are discussed. From microscopic view points, basics of stochastic process and related topics are given. From macroscopic ones, after the concept of entropy is revisited, applications in global enviroinments and hydrogen energy are described.

[Course Goals]

Microscopic Viewpoints: Ability of multi-scale modelling
Macroscopic Viewpoints: Ability of global environment modelling

[Course Schedule and Contents]

(M) Brownian Motion,1time,
(M) Transport Phenomena and Correlation Functions,1time,
(M) Spectral Analysis and Fractal Analysis,2times,
(M) Stochastic Process and Its Applications,3times,
(Y) Science of Atmosphere and Ocean,5times,
(Y) Science of Hydrogen Energy,1time,
(Y) Science of Nuclear Energy,1time,
Check and feedback,1time,

[Class requirement]

Elementary thermodynamics, Statistical physics, Heat transfer engineering, Numerical analysis etc.

[Method, Point of view, and Attainment levels of Evaluation]

Reports

[Textbook]

handout

[Reference books, etc.]

（Reference books）

Introduced during class

[Regarding studies out of class (preparation and review)]

Not necessary

（Others (office hour, etc.)）

(2018)
Matsumoto: April 8 ~ May 227
Yoshida: June 3 ~ July 22

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	基盤流体力学 Introduction to Advanced Fluid Dynamics	Affiliated department, Job title,Name	Graduate School of Engineering Professor,INAMURO TAKAJI Graduate School of Engineering Professor,HANAZAKI HIDESHI Graduate School of Engineering Professor,TAKATA SHIGERU

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Fri.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

, 5 times,
, 5 times,
, 4 times,
, 1 times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	量子物性物理学 Quantum Condensed Matter Physics	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HASUO MASAHIRO Graduate School of Engineering Associate Professor,NAKAJIMA KAORU Graduate School of Engineering Senior Lecturer,SENAMI MASATO

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Thu.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,3times,
,3times,
,4times,
,1time,
,1time,
,1time,
,1time,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	設計生産論 Design and Manufacturing Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,MATSUBARA ATSUSHI Graduate School of Engineering Associate Professor,IZUI KAZUHIRO Graduate School of Engineering Senior Lecturer,BEAUCAMP, Anthony Tadeus Herve

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Fri.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,2times,
,2times,
,3times,
,2times,
,3times,
,2times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	動的システム制御論 Dynamic Systems Control Theory	Affiliated department, Job title,Name	Graduate School of Engineering Professor,SAWARAGI TETSUO Graduate School of Engineering Senior Lecturer,NAKANISHI HIROAKI Graduate School of Engineering Professor,FUJIMOTO KENJI

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Tue.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,5times,
,5times,
,4times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	技術者倫理と技術経営 Engineering Ethics and Management of Technology	Affiliated department, Job title,Name	Graduate School of Engineering Professor,SAWARAGI TETSUO Graduate School of Engineering Senior Lecturer,NAKANISHI HIROAKI Graduate School of Engineering Professor,TOMITA NAOHIDE Graduate School of Engineering Professor,KOMORI MASAHARU Graduate School of Engineering Professor,MATSUBARA ATSUSHI Graduate School of Engineering Associate Professor,TSUCHIYA TOSHIYUKI

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Thu.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Basic knowledge of Engineering Ethics and Management of Technology needed for future project leaders in companies and society is taught. Students have to make group work after-class hours as well as presentations of wrapping-up the discussions. Engineering ethics is the field of applied ethics and system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession. Management of Technology is a set of management disciplines that allows organizations to manage their technological fundamentals to create competitive advantage. This course consists of lectures, exercises, discussions and oral presentations under supervision of professional faculties and extramural lecturers.

[Course Goals]

To cultivate a spirit of self-sufficiency needed for engineers

[Course Schedule and Contents]

Engineering Ethics,9times,1. Introduction to Engineering Ethics (EE)\\2.Medical Engineering Ethics\\3.EE by Institution of Professional Engineers, Japan and abroad\\4.Product Safety and Product Liability\\5. Comprehensive Manufacturing and EE (1) \\6.Comprehensive Manufacturing and EE (2)\\7.Group Discussions\\8.History and Philosophy of EE\\9.Presentation on exercise of EE
Management of Technology,5times,1.Product Portfolio, Strategy for Competition\\2.Bussiness Domain and MOT for Marketing\\3. Organizational Strategy for Corporates#039 R amp D\\4. Management Theory for R amp D\\5.Presentation on exercise of MOT
Summary,1time,

[Class requirement]

Nothing particular

Continue to 技術者倫理と技術経営(2)↓↓↓

技術者倫理と技術経営(2)

[Method, Point of view, and Attainment levels of Evaluation]

Submission of reports and presentations

[Textbook]

No textbook

[Reference books, etc.]

（Reference books）

Nothing

（Related URLs）

(No Web Site)

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

Nothing particular

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	破壊力学 Fracture Mechanics	Affiliated department, Job title,Name	Graduate School of Engineering Professor,KITAMURA TAKAYUKI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Fri.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The basics of the fracture mechanics will be lectured.
Elastic problem, Stress function of a crack, Stress field around a crack tip, Stress intensity factors, Energy release rate, J-integral, Elastic plastic fracture mechanics, Interfacial fracture mechanics etc.
Fracture toughness, Crackings in fatigue, environmental fatigue and creep-fatigue etc.

[Course Goals]

The objective of this lecture is to master the basic knowledge of the fracture mechanics, and to be able to discuss about material strength on the basis of the knowledge.

[Course Schedule and Contents]

Introduction,2times,Introduction\\ Examples of fracture in real components\\ Deformation and fracture\\Stress concentration and singular stress field\\ Basics of solid mechanics
Linear fracture mechanics,3times,Mechanics of cracked body under linear elasticity\\ Singular stress field near a crack tip, Stress intensity factor, Energy release rate, J-integral, Small scale yielding\\Interfacial fracture mechnics in dissimilar materials, Stress field near an interface edge, Stress field near an interfacial crack
Nonlinear fracture mechanics,2times,Fracture mechanics in non-linear elastic solid\\HRR singular field, J-integral, creep\\Stress field near an interface edge
farcture phenomenon and mechanics,3times,Application of fracture mechanics to fracture toughness\\ Application of fracture mechanics to fatigue cracking\\Application of fracture mechanics to environmental cracking\\Application of fracture mechanics to fatigue cracking at high temperatures
fracture mechanics on growth of small cracks,1time,Growth of physicall small crack\\Growth of microstrucually small crack
Smakk crack and cavity in creep ,1time,Cavity growth by diffusion creep\\Difference of stress filed between crack and cavity
Fracture nanomechanics,1time,Research works on fracture mechanics in nanometer scale
Fracture in atomic scale,1time,Research works on fracture in atomic scale
Summary,1time,Discussion and report

[Class requirement]

The traditional material strength and the linear elastic mechanics should be learned before taking this lecture.

[Method, Point of view, and Attainment levels of Evaluation]

Mini-reports will be evaluated.

Continue to 破壊力学(2)↓↓↓

破壊力学(2)

[Textbook]

The teacher provide articles for this lecture.

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	中性子物理工学 Neutron Physical Technology	Affiliated department, Job title,Name	Institute for Integrated Radiation and Nuclear Science Associate Professor,MORI KAZUHIRO Institute for Integrated Radiation and Nuclear Science Assistant Professor,ONODERA YUHEI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Mon.4	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,15times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	ロボティクス Robotics	Affiliated department, Job title,Name	Graduate School of Engineering Professor,MATSUNO FUMITOSHI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Mon.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Understanding of intelligent behaviors of living things is very interesting. And realization of their intelligent motion by a robot is also attractive for mechanical engineering. In this lecture, we consider basic understanding of beautiful human skill ldquomanipulationrdquo on the point of view of dynamics and control. First modeling methodologies for a rigid multibody system and a general dynamic model of a manipulator are provided. Next, a typical nonlinear control law is introduced and some problems for applying the controller are shown. Based on nature of the dynamics of the manipulator, a very simple and robust controller can be derived by designing energy of the system. This lecture provides modeling methodologies and controller design strategies of the rigid multibody system and we analyze a beautiful human skill of the manipulation.

[Course Goals]

[Course Schedule and Contents]

,1time,
,4times,
,1time,
,3times,
,3times,
,2times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

Continue to ロボティクス(2)↓↓↓

ロボティクス(2)

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	メカ機能デバイス工学 Mechanical Functional Device Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,KOMORI MASAHARU Graduate School of Engineering Professor,HIRAYAMA TOMOKO

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Wed.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

For any machines, prime movers and powertrains are necessary to realize the required functions. In automobiles, an engine is the prime mover and a transmission, a clutch, and a shaft are parts of the powertrain. In machine tools, a motor is used as the prime mover and the powertrain uses feed screws. In this lecture, the prime mover is taken up. Types, characteristics, principles, advantages and disadvantages of the prime mover are explained. Students also learn the basics of tribology, surfaces and contacts, friction, wear, lubrication theory, dynamic guide, hydrostatic guide, rolling guide, oil seal, mechanical seal, packing.

[Course Goals]

Understand the principles and basic characteristics of the prime movers and tribology taken up in the lecture.

[Course Schedule and Contents]

Outline,1time,Composition of mechanical device, examples of prime movers, working parts, and powertrains, examples of actuators
Electromagnetic force,2times,Principle used for actuators, type of electromagnetic motor, principle and characteristics of synchronous motor, generating method of rotating magnetic field, induction motor, reluctance motor, DC motor, stepping motor
Electrostatic force, piezoelectric,2times,Usage of electrostatic force as actuator, explanation of principle and characteristics, piezoelectric effect, characteristics of piezoelectric effect, piezoelectric material, polarization, displacement and force, hysteresis, type and basic structure, application
Fluid pressure, ultrasonic, shape memory alloy,2times,Fluid pressure actuator, ultrasonic motor, shape memory effect, shape recovery
Tribology,5times,foundation of tribology, surface and contact, friction, wear, lubrication theory
Guide,1time,dynamic guide, hydrostatic guide, rolling guide
Seal,1time,oil seal, mechanical seal, packing
Feedback class,1time,Answer questions

[Class requirement]

Nothing.

[Method, Point of view, and Attainment levels of Evaluation]

Evaluate comprehensively by participation in class, tests, reports, etc.

Continue to メカ機能デバイス工学(2)↓↓↓

メカ機能デバイス工学(2)

[Textbook]

Instruct as necessary.

[Reference books, etc.]

（Reference books）

Instruct as necessary.

[Regarding studies out of class (preparation and review)]

Review the handouts

（Others (office hour, etc.)）

Schedule of lecture may be changed according to circumstances. Supplement in English as necessary.

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	機械理工学基礎セミナーA Basic Seminar on Mechanical Engineering and Science A	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI

Target year		Number of credits	2	Course offered year/period	2019/Intensive, First semester
Day/period	Intensive	Class style	Seminar	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,10times,
,5times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	機械理工学基礎セミナーB Basic Seminar on Mechanical Engineering and Science B	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI

Target year		Number of credits	2	Course offered year/period	2019/Intensive, Second semester
Day/period	Intensive	Class style	Seminar	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,10times,
,5times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	有限要素法特論 Advanced Finite Element Method	Affiliated department, Job title,Name	Graduate School of Engineering Professor,NISHIWAKI SHINJI

Target year		Number of credits	2	Course offered year/period	2019/First semester

Day/period	Wed.2	Class style	Lecture	Language	English

[Outline and Purpose of the Course]

This course presents the basic concept and mathematical theory of the Finite Element Method (FEM), and explains how the FEM is applied in engineering problems. We also address important topics such as the physical meaning of geometrical non-linearity, material non-linearity, and non-linearity of boundary conditions, and we explore numerical methods to deal with these nonlinearities. Also, we guide students in class in the use of software to solve several numerical problems, to develop practical skill in applying the FEM to engineering problems.

[Course Goals]

The course goals are for students to understand the mathematical theory of the FEM and the numerical methods for analyzing non-linear problems based on the FEM.

[Course Schedule and Contents]

Basic knowledge of the FEM,3times,What is the FEM? The history of the FEM, classifications of partial differential equations, linear problems and non-linear problems, mathematical descriptions of structural problems (stress and strain, strong form and weak form, the principle of energy).
Mathematical background of the FEM,2times,Variational calculus and the norm space, the convergence of the solutions.
FEM formulations,3times,FEM approximations for linear problems, formulations of iso-parametric elements, numerical instability problems such as shear locking, formulations of reduced integration elements, non-conforming elements, the mixed approach, and assumed-stress elements.
Classifications of nonlinearities and their formulations,4times,Classifications of nonlinearities and numerical methods to deal with these nonlinearities.
Numerical practice,2times,Numerical practice using COMSOL.
Evaluation of student achievements,1time,

[Class requirement]

Solid Mechanics

[Method, Point of view, and Attainment levels of Evaluation]

Grading is based the quality of two or three reports and the final exam.

Continue to 有限要素法特論(2)↓↓↓

有限要素法特論(2)

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

Bath, K.-J., Finite Element Procedures, Prentice Hall \Belytschko, T., Liu, W. K., and Moran, B.., Nonlinear Finite Elements for Continua and Structures, Wiley

[Regarding studies out of class (preparation and review)]

N/A

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	先進材料強度論 Strength of Advanced Materials	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HOUJIYOU MASAKI Graduate School of Engineering Associate Professor,NISHIKAWA MASAAKI

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Thu.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The mechanism underlying mechanical and functional properties are lectured for advanced materials used and developed in advanced fields of current engineering. In particular, advanced composite materials, used for aircraft structure etc., are introduced, with a detailed description of the relationship between microscopic constituent materials and macroscopic properties from the perspective of multiscale mechanics; also the anisotropy of their properties, their fatigue and fracture properties are described in the basic discipline for strength of materials. The latest applications are introduced in the field of various transportation systems including airplanes.

[Course Goals]

The course goal is to understand basic concepts of composite materials and the underlying mechanism of their mechanical properties from multiscale viewpoints, while the phsyical understanding of composites is developed based on multiple disciplines.

[Course Schedule and Contents]

Concept of composite materials,2times,The concept and definition of composite materials, their constituent materials and manufacturing methods are illustrated. Their application to aircraft structures etc. are also introduced.
Mechanical properties of microscopic constituent materials,2times,Resin for matrix and various fiber types are explained including their structure and mechanical properties. The weakest link model and Weibull distribution are described as a basis of the statistic nature of strength.
Basic mechanical properties,4times,The specific strength, the specific stiffness, and the rule of mixture for elastic modulus and strength are lectured. In particular, the detailed explanation is made to the anisotropy of elastic modulus, independent elastic constants in the generalized Hookean law, the anisotropic failure criteria, and laminate theory. The relationship between the mechanical properties of microscopic constituent materials and macroscopic properties of composite materials is also illustrated.
Micromechanics,2times,The mechanism of transverse fracture is illustrated. The mechanical models are described for short fiber reinforced composites and particle dispersed composites. The micromechanical analyses based on finite element method is also illustrated for the physical understanding of the strength of composite materials.
Fracture mechanics properties,2times,Fracture mechanics of anisotropic materials are described. The interlaminar fracture toughness and interlaminar fatigue crack propagation, the critical issues in the application of composite structures, are explained including their underlying mechanism.
Superconducting materials,1time,High-temperature superconducting materials are the composite materials consisting of metals and fibrous superconducting materials made of oxides. The mechanism are explained for understanding that their mechanical properties so much control their electric properties.
Process and mechanical properties of composite materials,1time,The molding and machining process of composite materials is explained to relate it to their mechanical properties. Fiber preform, the selection of resin, intermediate materials, machining and assembly and inspection methods are overviewed from the

Continue to 先進材料強度論(2)↓↓↓

先進材料強度論(2)

academic viewpoints.
Academic achievement test,1time,Academic achievements is assessed.

[Class requirement]

Mechanics of Materials, Continuum Mechanics, Fundamentals of Materials, Solid Mechanics, Adv.

[Method, Point of view, and Attainment levels of Evaluation]

Grading is based on the reports. The assignments will be given around three times.

[Textbook]

Supplementary handouts will be distributed in the class.

[Reference books, etc.]

（Reference books）

D.Hull and T.W.Clyne, An Introduction to Composite Materials, Cambridge University Press.

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

The order and the item in the course are possibly subject to change.

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	熱物性論 Thermophysics for Thermal Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Associate Professor,MATSUMOTO MITSUHIRO Graduate School of Engineering Professor,KUROSE RYOUICHI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Fri.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Based on elementary thermodynamics and statistical physics, I will describe non-equilibrium thermodynamics and advanced statistical physics, including phase transition, pattern formation, and entropy production.

[Course Goals]

Understanding the principle mechanisms of phase transition, cooperation phenomena, patern formation, and relaxation phenomena, in terms of advanced statistical mechanics and non-equilibrium thermodynamics.

[Course Schedule and Contents]

Elementary statistical physics: review,1time,Review of equilibrium statistical mechanics
Phase transition as a cooperative phenomenon,3times,Statistical mechanics of interacting particle system\\ - Exact calculation\\ - Monte Carlo simulation\\ - Mean field approximation
Pattern formation of non-equilibrium systems,3times,After a time dependent Ginzburg-Landau (TDGL) model is introduced, formation of spatial patterns is discussed from various viewpoints.
Equilibrium thermodynamics: review,2times,Review of elementary thermodynamics
Non-equilibrium thermodynamics: Basics,5times,System stability and the principle of irreversible process are discussed in terms of thermodynamics.
Non-equilibrium thermodynamics: Applications,3times,- Entropy production\\ - Linear response theory\\ - Onsager#039s reciprocal relation
Check and Feedback,1time,

[Class requirement]

Undergraduate level of Thermophysics, Heat transfer phenomena, and Statistical physics

[Method, Point of view, and Attainment levels of Evaluation]

Paper assignments

[Textbook]

Lecture note will be prepared.

[Reference books, etc.]

（Reference books）
will be listed in the class.

[Regarding studies out of class (preparation and review)]

Exercises with simple numerical simulations are given.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	熱物質移動論 Transport Phenomena	Affiliated department, Job title,Name	Graduate School of Engineering Professor,NAKABE KAZUYOSHI Graduate School of Engineering Associate Professor,TATSUMI KAZUYA

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Fri.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The important learning objective of this class is to understand the fundamental mechanisms of momentum, heat, and mass transfer phenomena, the knowledge of which will be markedly required for the thermal energy control technologies to further practice conservations of natural resources and energies for sustainable development. Heat and mass transfer processes consisting of conduction and forced/natural convection will be highlighted in detail, referring to the similarity characteristics of flow velocity, fluid temperature, and species concentration. Some topics on Reynolds stress, turbulent heat flux, and phase change will be introduced, expanding to their numerical models, together with some recent trends of high-tech heat and energy devices.

[Course Goals]

To understand the basic knowledge of velocity-temperature-concentration fields under the thermo-fluid conditions of conduction, forced convection, and natural (or free) convection. Also, to acquire these knowledge to make a suitable thermal engineering analysis when you encounter heat and mass transfer problems in the future.

[Course Schedule and Contents]

1. Introduction and Surrounding Examples of Transport Phenomena
2. - 4. Governing Equations and Non-Dimensional Parameters
5. - 7. Boundary Layer Flows
8. - 9. External and Internal Flows
10. - 11. Turbulent Phenomena
12. - 14. Topics of Flow and Heat Transfer Mechanism
15. Final Examination / Learning Achievement Evaluation
16. Feedback

[Class requirement]

It'll be desireable to take lectures of core subjects 'Introduction to Advanced Fluid Dynamics' and 'Thermal Science and Engineering.'

[Method, Point of view, and Attainment levels of Evaluation]

Evaluation will be based on active participation, assignments, and written examination.

[Textbook]

Textbooks are not specified. Printed materials for the lecture will be distributed properly.

Continue to 熱物質移動論(2)↓↓↓

熱物質移動論(2)

[Reference books, etc.]

（Reference books）

For example, 'Transport Phenomena (Bird, R.B. et al.)', etc.

[Regarding studies out of class (preparation and review)]

Preparation and review are required using the printed materials distributed in the class.

（Others (office hour, etc.)）

The thema order of the lecture can be changed, depending on the classwork progressing.

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	光物理工学 Engineering Optics and Spectroscopy	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HASUO MASAHIRO Graduate School of Engineering Associate Professor,SHIKAMA TAIICHI

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Tue.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Optics are widely used in many areas of modern science and technology. Students will learn the physical properties of light and light-matter interactions, and their applications. Topics such as light propagation in dielectric media, crystal optics, quantum optics, and lasers will be explored. Interactions of light with atoms, molecules and solids as examples will be also explored with introduction of the fundamentals of spectroscopy and their applications.

[Course Goals]

Understand the principles of optical engineering and spectroscopy.
Develop application abilities based on the principle understanding.

[Course Schedule and Contents]

Dispersion of light,6times,propagation of light in dielectric media (Lorentz model), crystal optics, nonlinear optics
Quantum optics,1time,quantum theory of light, principles of lasers
Light-matter interactions,5times,light-induced transition, quantum states of atoms, molecules, and solids, and rules governing the transitions (selection rules)
Selection rules and group theory,2times,introduction to group theory and its application to the selection rules
Confirmation of the achievement,1time,

[Class requirement]

Undergraduate-level electromagnetism and quantum mechanics.

[Method, Point of view, and Attainment levels of Evaluation]

Grade evaluation will be based on report examination.

[Textbook]

Recommended books will be discussed in class.

[Reference books, etc.]

（Reference books）
Lecture notes will be distributed.

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	最適システム設計論 Optimum System Design Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,NISHIWAKI SHINJI Graduate School of Engineering Associate Professor,IZUI KAZUHIRO Graduate School of Engineering Assistant Professor,YAMADA TAKAYUKI

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Thu.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,1time,
,4times,
,2times,
,5times,
,2times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	高エネルギー材料工学 High Energy Radiation Effects in Solid	Affiliated department, Job title,Name	Institute for Integrated Radiation and Nuclear Science Associate Professor,JIYO GIYUU Institute for Integrated Radiation and Nuclear Science Professor,KINOMURA ATSUSHI Institute for Integrated Radiation and Nuclear Science Assistant Professor,YABUUCHI ATSUSHI

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Fri.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Selection, fabrication and deterioration of materials are important factors for mechanical system design. It is necessary to understand conditions under which selected materials are actually used. In particular, special design policies are required for the materials used under irradiation of high-energy particles and radiation. On the other hand, it is possible to intentionally make use of property changes of materials by high-energy particle irradiation.

Irradiation of high-energy particles such as accelerated neutrons, ions and electrons deposits very high energies at local regions. Such irradiated regions undergo extreme conditions which cannot be realized by other methods. As a result, the irradiation leads to significant structural and stoichiometric changes in materials. This lecture gives general description of materials irradiation effects, irradiation effects on materials related to nuclear power plants, and academic/industrial applications of materials fabrication/ analysis by using high-energy particles.

[Course Goals]

To understand reactions and property changes of materials under radiation and high-energy particle irradiation.

[Course Schedule and Contents]

,15times,(1) Introduction\\ (2) Scattering of high-energy particles with atoms in solids\\ (3) Displacement of atoms in solids by high-energy particles\\ (4) Motion and behaviors of point defects\\ (5) Rate equation of point defects and secondary-defect formation\\ (6) The influence of irradiation on material properties\\ (7) Activation of materials\\ (8) High-energy particle sources\\ (9) Ion beam fabrication\\ (10) Ion beam analysis\\ (11) Electron beam applications\\ (12) Materials irradiation studies\\ (13) Neutron irradiation effects and nuclear materials\\ (14) Positron analysis\\

[Class requirement]

Basic knowledge on materials engineering and mechanics

[Method, Point of view, and Attainment levels of Evaluation]

Grading is based on small quizzes and report submission (if necessary) on the lecture.

Continue to 高エネルギー材料工学(2)↓↓↓

高エネルギー材料工学(2)

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	先端物理工学実験法 Advanced Experimental Techniques and Analysis in Engineering Physics	Affiliated department, Job title,Name	Institute for Integrated Radiation and Nuclear Science Associate Professor,JIYO GIYUU Institute for Integrated Radiation and Nuclear Science Associate Professor,MORI KAZUHIRO Institute for Integrated Radiation and Nuclear Science Professor,KINOMURA ATSUSHI

Target year		Number of credits	2	Course offered year/period	2019/Intensive, year-round
Day/period	Intensive	Class style	Seminar	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	デザインシステム学 Theory for Design Systems Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,SAWARAGI TETSUO Graduate School of Engineering Senior Lecturer,NAKANISHI HIROAKI

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Fri.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The lecture focuses on the human design activity; designing artifacts (things, events and systems) based on human intuitions, and designing human-machine systems in which the relations between human and objects are of importance.

[Course Goals]

[Course Schedule and Contents]

,2times,
,2times,
,3times,
,3times,
,2times,
,2times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	バイオメカニクス Biomechanics	Affiliated department, Job title,Name	Institute for Frontier Life and Medical Sciences Professor,ADACHI TAIJI

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Wed.2	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

Introduction,1time,
,2times,
,4times,
,4times,
,4times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	医工学基礎 Introduction to Biomedical Engineering	Affiliated department, Job title,Name	Graduate School of Engineering Professor,TOMITA NAOHIDE

Target year		Number of credits	2	Course offered year/period	2019/Intensive, First semester
Day/period	Intensive	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Understand　basic concepts related to clinical medicine and medical engineering**.**　And expand the range of research by exchange each engineering knowledge and experience.

[Course Goals]

Expand the range of research through exchanges with other fields.

[Course Schedule and Contents]

Introduction to medicine for engineering students, **1** times,
Introduction to Medical Engineeri, **1** times,
Cross-field workshop, **1　3** times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Participate to the workshops submit a report

[Textbook]

Not fixed

[Reference books, etc.]

（Reference books）
Introduced during class

[Regarding studies out of class (preparation and review)]

Summarize each own research content.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code	G-ENG05 6Q402 LB71		
Course title <English>	乱流力学 Turbulence Dynamics	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HANAZAKI HIDESHI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Tue.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

流体力学の自然現象や工学への適用においては、浮力やコリオリ力の効果が重要となる。それらの効果が顕著となる成層流体や回転流体を例にとり、流体中の波動や乱流についての基礎事項を学習する。

[Course Goals]

流体中の波動や乱流の基礎事項を、成層流体や回転流体を主な例にとり、学習する。

[Course Schedule and Contents]

１．成層流体の基本的性質（4回）：鉛直方向に密度差のある成層流体が持つ、基本的な（特殊な）性質について解説する（成層流体の支配方程式、静水圧平衡、物体を過ぎる流れとブロッキング、浮力振動数、渦位の保存則、ブシネスク近似）。

２．流体中の波動（5回）：位相速度と群速度、波の線形分散関係、成層流体中の内部重力波、物体による内部重力波の励起と伝播。

３．乱流（3回）：一様等方性乱流（慣性領域と散逸領域、次元解析とKolmogorovスケール）、成層乱流（Ozmidovスケール、運動エネルギーと位置エネルギーのエネルギー交換、密度の鉛直フラックスによる熱・物質輸送）。

４．拡散（2回）：拡散方程式と平均２乗変位、乱流拡散（Taylor拡散、短時間極限と長時間極限）

５．フィードバック（1回）

[Class requirement]

前提とするのは、学部レベルの基礎的な流体力学（質量保存の式、流体の運動方程式、ベルヌイの定理、基本的なベクトル解析）。

[Method, Point of view, and Attainment levels of Evaluation]

学期末のレポートにより評価する。ただし、学期途中のレポート評価も加味する（２割程度）。

【評価基準】
到達目標について、
A＋：すべての観点においてきわめて高い水準で目標を達成している。
A　：すべての観点において高い水準で目標を達成している。
B　：すべての観点において目標を達成している。
C　：大半の観点において学修の効果が認められ、目標をある程度達成している。
D　：目標をある程度達成しているが、更なる努力が求められる。

Continue to 乱流力学 (2)↓↓↓

乱流力学 (2)

Ｆ　：学修の効果が認められず、目標を達成したとは言い難い。

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

Introduced during class

[Regarding studies out of class (preparation and review)]

学期途中に適宜出題するレポートの提出を通じて、要点を復習することが望ましい。

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	原子系の動力学セミナー Seminar: Dynamics of Atomic Systems	Affiliated department, Job title,Name	Graduate School of Engineering Associate Professor,MATSUMOTO MITSUHIRO Graduate School of Engineering Professor,INOUE YASUHIRO Graduate School of Engineering Senior Lecturer,MATSUMOTO RIYOUSUKE Graduate School of Engineering Associate Professor,SHIMADA TAKAHIRO Graduate School of Engineering Associate Professor,NISHIKAWA MASAAKI

Target year		Number of credits	2	Course offered year/period	2019/First semester
Day/period	Tue.5	Class style	Lecture	Language	Japanese and English

[Outline and Purpose of the Course]

Particle simulations are a tool of analyzing microscopic phenomena, and widely used in various fields of science and engineering. After providing the basics of particle simulation methods through lectures and exercises, we show various practical applications in thermofluids, solid materials, biophysics, and quantum systems.

[Course Goals]

- Understanding the basics of particle simulations
- Mastering data analysis techniques

[Course Schedule and Contents]

Basics of MD simulations (M.Matsumoto),6times,- Numerical simulation of equations of motion\\ - Model potentials\\ - Data analysis\\ - Equilibrium vs. non-equilibrium
Application: Thermofluidal systems (M. Matsumoto),2times,- Lennard-Jones fluids\\ - Interface, phase change, energy transport, etc.
Application: Polymeric materials (Nishikawa),2times,- Fundamentals on mechanical (viscoelastic) properties of polymer materials\\ - Application of molecular dynamics method of polymer materials
Application: Biosystems (Inoue),1time,- MD simulation of biomolecular systems\\ - Recent examples
Application: Solid systems (R. Matsumoto),1time,- Deformation and destruction\\ - Alternative methods
Application: Quantum systems (Shimada),2times,- First principle MD\\ - Mechanical and electronic properties on nanoscale
Check and Feedback,1time,

[Class requirement]

Elementary Level of
Analytical mechanics, Quantum mechanics, Material science, Thermodynamics, Statistical physics, Numerical analysis

Continue to 原子系の動力学セミナー(2)↓↓↓

原子系の動力学セミナー(2)

[Method, Point of view, and Attainment levels of Evaluation]

Reports, presentation/discussion

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

Introduced during class

[Regarding studies out of class (preparation and review)]

Exercises with simple C programs are given, with which you will understand the concepts deeply.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	中性子材料工学セミナーⅠ Neutron Science Seminar I	Affiliated department, Job title,Name	Institute for Integrated Radiation and Nuclear Science Associate Professor,JIYO GIYUU Institute for Integrated Radiation and Nuclear Science Professor,KINOMURA ATSUSHI

Target year		Number of credits	2	Course offered year/period	2019/Intensive, First semester

Day/period	Intensive	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,1\\3\\2\\2-3\\2-3\\\\\\2\\2times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	中性子材料工学セミナーII Neutron Science Seminar II	Affiliated department, Job title,Name	Institute for Integrated Radiation and Nuclear Science Associate Professor,MORI KAZUHIRO

Target year		Number of credits	2	Course offered year/period	2019/Intensive, Second semester
Day/period	Intensive	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,2times,
,2times,
,2times,
,9times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	現代科学技術特論（8回コース） Advanced Modern Science and Technology (8 times course)	Affiliated department, Job title,Name	Graduate School of Engineering Senior Lecturer,ASHIDA RIYUUICHI Graduate School of Engineering Senior Lecturer,MATSUMOTO RIYOUSUKE Graduate School of Engineering Senior Lecturer,MAEDA MASAHIRO Graduate School of Engineering Senior Lecturer,YOROZU KAZUAKI Graduate School of Engineering Senior Lecturer,KANEKO KENTAROU

Target year		Number of credits	1	Course offered year/period	2019/Second semester
Day/period	Thu.5	Class style	Lecture	Language	English

[Outline and Purpose of the Course]

Engineering/Engineers have been expected to fulfill key roles among social issues and others, such as energy, environment and resource. This class introduces cutting edge science and technologies from their backgrounds, research and development, to problems for the practical applications. Group discussions will be done for further understanding of the topics of the course.

[Course Goals]

The students understand of each technology towards social issues to be solved by engineers. In addition, the students learn the importance for engineers to have multidisciplinary mind and understand the significance of engineering to realize sustainable development.

[Course Schedule and Contents]

Topic I Computer-Aided Analyses for Fluid
Week 1-2, Lagrangian Meshfree Methods as New Generation Computational Tools
Week 3, CFD in Process Systems Engineering
Week 4, CFD in Hydraulic Engineering
Topic II Utilization of Light Energy
Week 5-6, Photochemistry of Organic Molecules
Week 7, Solar Energy Conversion Using Semiconductor Photocatalysts
Week 8, Efficiency Improvement in Solar Cells by Photonic Nano Structures
Topic III Materials Analysis
Week 9-10,Crystal Structure Analysis by Power X-ray Diffraction Measurement
Week 11-12, Principles and Applications of Fluorescence Spectroscopy

[Class requirement]

Each topic consists of four lectures.
This course requests to choose two topics from provided three topics in advance.
It is prohibited to change the topics after registration.

[Method, Point of view, and Attainment levels of Evaluation]

The average score of the best two assignments for each topic is employed.
For each topic which the students chose, they must attend minimum three lectures and submit minimum two assignments evaluated as "passed".

Continue to 現代科学技術特論（8回コース）(2)↓↓↓

現代科学技術特論（8回コース）(2)

[Textbook]

Course materials will be provided.

[Reference books, etc.]

（Reference books）

（Related URLs）

http://www.glc.t.kyoto-u.ac.jp/grad(The home page of the engineering education research center)

[Regarding studies out of class (preparation and review)]

This course requests students to prepare a class in advance becouse some classes will be done by an interactive style as necessary.

（Others (office hour, etc.)）

It is prohibited to change the registered course.
It is prohibited to attend the lectures of the other topic than the students chose.
All the students are requested to attend the guidance which will be held on the first class.

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	複雑系機械システムのデザイン Design of Complex Mechanical Systems	Affiliated department, Job title,Name	Graduate School of Engineering Professor,SAWARAGI TETSUO Graduate School of Engineering Professor,TOMITA NAOHIDE Institute for Frontier Life and Medical Sciences Professor,ADACHI TAIJI Graduate School of Engineering Professor,NISHIWAKI SHINJI Graduate School of Engineering Associate Professor,TSUCHIYA TOSHIYUKI Graduate School of Engineering Professor,KOMORI MASAHARU

Target year		Number of credits	2	Course offered year/period	2019/Second semester
Day/period	Fri.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,2times,
,2times,
,2times,
,2times,
,2times,
,2times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

Continue to 複雑系機械システムのデザイン(2)↓↓↓

複雑系機械システムのデザイン(2)

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	アーティファクトデザイン論 Theory for Designing Artifacts	Affiliated department, Job title,Name	Graduate School of Engineering Professor,SAWARAGI TETSUO

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Wed.5	Class style	Lecture	Language	English

[Outline and Purpose of the Course]

The activity of design is fundamentally similar across a wide variety of domains. I use artifact in a broad and atypical sense to describe any product of intentional creation, including physical goods, services, information systems, buildings, landscapes, organizations, and societies. The central theme of this lecture is that a unifying framework informs the human activity of design across all domains. Especially, understanding user needs is a key element of problem definition, and that understanding is usually best developed with interactive and immersive methods. In this lecture, a variety of methodologies for participatory systems approach and an idea of user-experience are provided, and its contributions to the design process are discussed.

[Course Goals]

This course is aimed at developing the ability to apply methods for identifying problems and interactively analyzing/evaluating systems, based on understanding of the principles of artifact design and on systematic thinking.

[Course Schedule and Contents]

Introduction,1time,We will shed light on the concept of artifacts as something to be put on equal footing with natural objects and examine the history of artifacts in terms of how they were viewed in different ages? namely, artifacts as modes of representation in the ancient world, artifacts as necessities for survival in the middle ages, artifacts as forms of convenience in modern times, and artifacts as a means of perpetuation in the current era.
Artifact function and purpose,3times,The effects that artifacts have on the outside world?i.e., other things?are ldquofunctions.rdquo Function is the concept of questioning the existence of an artifact, and design is the formulation of functions for achieving an intended purpose. We will discuss the categorization of artifacts in terms of how the ldquopurposerdquo of artifacts relates to the context in which they are used, and look at the origins of artifacts from the perspective of semiosis.
Artifact design principles,2times,To understand an artifact is to know how its internal structure acts on the outside world to realize its function. Today, cybernetics?which has explored the interaction between the physical world and the world of information?is expanding into a concept that encompasses society as well (second-order cybernetics), and concepts have been put forward for actively rethinking how human cognition and decision-making interact with the outside world (ecological approaches, socially distributed cognition, naturalistic decision-making). We will examine artifact design principles based on theories related human activity at the boundary of these externalities.
Artifact design representation and evaluation,3times,Design must fulfill its role of enhancing the quality of life through the creation of not only individual artifacts, but also environments and social systems that encompass groups of artifacts and natural objects. We will discuss the path toward expanding the scope of design from physical objects to environments and social systems that include intangible services, including with regard to problem development/representation methods, how to set purposes of design, how to eliminate the ambiguities and conflicts among various goals, searching for alternative design strategies, design

Continue to アーティファクトデザイン論(2)↓↓↓

evaluation, and principles and methods of consensus-forming among different stakeholders.
User-centered artifact design,2times,The quality of designs is something to be evaluated by the user, and hence there must be collaboration between users and designers/producers. Moreover, complex design challenges cannot be resolved by experts of only one discipline; they must be tackled by pooling the design-related knowledge of different domains. We will discuss the concept of user-centered design, design rationale, and international standards of design processes for achieving design that is grounded in the userrsquos needs/ perspective.
Participatory systems approach,2times,In order to deal with the design of large-scale, complex artifacts, one must take the approach of systemically structuring problems and basing design on diverse perspectives. We will broadly examine: interactive processes among system designers, users, and computers; methods of structurally modeling problems through repeated dialogue between experts in relative disciplines and computers; and ways of supporting the perceptions, interpretations, and decision-making of designers and users. We will also consider the utility of the participatory systems approach in smooth, effective implementation of system design.
Exercise in participatory systems approach,2times,Students will apply the participatory systems approach to a real-world artifact design challenge, and report the results of this exercise.

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Students will be evaluated based on the following criteria, in the order listed. (1) Exercises assigned in class: approx. 20% (2) Final exam: approx. 60% (3) Contributions to classwork (e.g., asking good questions): approx. 20%

[Textbook]

Lecture notes used in class will be distributed as needed. Refer to ldquoTextbook (supplemental)rdquo below.

[Reference books, etc.]

（Reference books）

1. **吉川弘之** [2007] **人工物観**, **横幹**, 1(2), 59-65 2. Suh, N.P. [1990] The Principles of Design, Oxford University Press （**邦訳：スー(翻訳：畑村洋太郎)「設計の原理? 創造的機械設計論」**, **朝倉書店**, 1992.） 3. **吉川弘之** [1979] **一般設計学序説**, **精密機械**45 (8) 20?26, 1979. 4. Vladimir Hubka and W. Ernst Eder [1995] Design Science, Springer 5. Simon,H.[1996] The Sciences of the Artificial Third edition **秋葉元吉、吉原英樹訳**[1999]**『システムの科学』パーソナルメディア** 6. H・A・**サイモン**[1979] **稲葉元吉・倉井武夫訳**, **『意思決定の科学』**,**産業能率大学出版部** 7. Hutchins, Edwin [1995] Cognition in the Wild. MIT Press 8. Klein, G., Orasanu, J., Calderwood, R., and Zsambok, C.E. [1993] Decision Making in Action: Models and Methods. Ablex Publishing Co., Norwood, NJ. 9. D・**ノーマン**[1986] The Design of Everyday Things, **野島久雄訳『誰のためのデザイン?：認知科学者のデザイン原論』、新曜社** 10. **椹木、河村**[1981]**：参加型システムズ・アプローチ―手法と応用、日刊工業新聞社ほか**

[Regarding studies out of class (preparation and review)]

Continue to アーティファクトデザイン論(3)↓↓↓

アーティファクトデザイン論(3)

（Others (office hour, etc.)）

Office hours will be held for one hour before and after each class period (preferably 5th period on Tuesdays, but also 3rd period on Wednesdays). Appointments for other times can be requested by e-mail.

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	金属結晶学 Crystallography of Metals	Affiliated department, Job title,Name	Graduate School of Engineering Associate Professor,SUMIGAWA TAKASHI

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Thu.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

Metallic crystal structure and deformation behavior are lectured on the basis of metal physics and dislocation theory. Especially, mechanical properties of dislocation and its substructure, which is changed in association with deformation, are introduced, and the effect of grain boundary and free surface on dislocation motion is explained.

[Course Goals]

The objective of this lecture is to deepen a further understanding of crystal growth methods, the dislocation theory and industrial problems.

[Course Schedule and Contents]

Introduction,1time,Introduction\\ Ideal strength and slip deformation\\ Concept of dislocation\\ Simulation
Basis of crystallography,1time,Typical crystallographic structure\\ Allotropic transformation\\ Stereographic projection of crystal
High temperature and vacuum techniques,1time,Furnace\\ Vacuum pump
Crystal breeding,2times,Single- and bi-crystal growth\\ Crystal growth\\ Vapor deposition and thin film\\
Dislocation theory,3times,Plastic deformation of crystal\\ Definition and type of dislocation\\ Strain field around dislocation\\ Dislocation reaction\\ Dislocation multiplication
Mechanical properties of single- and bi-crystals,1time,Dislocation substructure\\ Grain boundary structure\\ Reaction between dislocation and grain boundary\\ Deformation of micro- and nano- materials\\
Fatigue,3times,Fatigue of single crystal\\ Fatigue dislocation substructure\\ Fatigue cracking mechanism\\ Fatigue of micro- and nano- materials
Observation and analysis techniques,2times,Introduction of electron microscope and observation case
Summary,1time,Discussion and report

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Reporting assignment

[Textbook]

The teacher provide articles for this lecture.

[Reference books, etc.]

（Reference books）

Continue to 金属結晶学(2)↓↓↓

金属結晶学(2)

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code	G-ENG05 5G061 LJ71　G-ENG06 5G061 LJ71		
Course title <English>	応用数理科学 Applied mathematical sciences	Affiliated department, Job title,Name	Graduate School of Engineering Professor,INOUE YASUHIRO

Target year		Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Mon.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

数理科学は、様々な分野における数理的な課題解決に応用されている。特に、支配法則が明確でない複雑性の高い現象や不確実性を伴う現象を理解し予測する上では、数学的アイデアにもとづく数理モデルの構築が重要となる。本講義では、このような応用的な観点から、数理科学の実践について学ぶ。

[Course Goals]

数理的な課題解決に必要となる共通の考え方について学び、微分方程式および確率・統計を用いた数理モデル構築の技術に習熟する。

[Course Schedule and Contents]

○概論（1）　数理モデルの構築に必要となる考え方を学ぶ。

○微分方程式による数理モデル（5）線形微分方程式および非線形微分方程式の観点から、数理モデルを紹介し、少数の共通した数理モデルにより、広範な分野における非常に多様な現象を表現することができることを学ぶ。

○確率・統計による数理モデル（4）不確実性を伴う現象を理解する上で重要となる確率・統計の考え方を紹介し、確率微分方程式による数理モデルの構築や種々のデータに基づく統計モデルの構築の基礎を学ぶ。

○グループワーク（4）支配法則が明確でない諸現象に対して、数理モデルによる課題解決の実践をグループワークにより行う。数理的な課題解決プロセスを体験することにより、数理モデルの構築に必要となる考え方の取得を目指す。

○学修到着度の確認(1) 学修到達度の確認を行う。

[Class requirement]

微積分、確率・統計に関する基本的な知識

[Method, Point of view, and Attainment levels of Evaluation]

講義中に行うグループワークおよびレポート試験による。

Continue to 応用数理科学(2)↓↓↓

応用数理科学(2)

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

Introduced during class

[Regarding studies out of class (preparation and review)]

講義資料による復習を充分行うこと。

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	インターンシップM（機械工学群） Engineering Internship M	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HASUO MASAHIRO Graduate School of Engineering Professor,KUROSE RYOUICHI

Target year	1st year students or above	Number of credits	2	Course offered year/period	2019/Intensive, Second semester

Day/period	Intensive	Class style	Practical training	Language	Japanese

[Outline and Purpose of the Course]

The aim of the internship is experiencing on-site activities involved production, manufacturing, development, designing and research of industrial goods at a factory or a research laboratory of Japanese leading companies.

On-site learning of the importance of teamwork and production processes in manufacturing is also the aim.

[Course Goals]

The goal of the internship is to master a general method of thinking and methodology at Mechanical Engineering. Furthermore, by learning the relationship between a human and machines at an industry, motivate oneself to study and think about one's career development.

[Course Schedule and Contents]

As a general rule, the internship should meet the above purpose. The duration should be not less than two weeks. Thus, the following cases are not approved as an internship; a short internship such as a week, a company tour, a company explanation meeting and so on. Longer term more than two weeks and an overseas internship such as IAESTE can be acceptable.
Internship location: Based on recruitment from companies. You can find them at company's web sites and/or the educational affairs office of the Engineering Science office (Butsuri Kyoumu).

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Credits (2) are approved based on the summary report (50%) and presentation (50%) about the internship activities.

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

Consult with the internship host location.

（Others (office hour, etc.)）

Pre-registration at the educational affairs office of the Engineering Science (Butsuri Kyoumu) is required.

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	機械理工学特別実験及び演習第一 Experiments on Mechanical Engineering and Science,Adv. I	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI

Target year		Number of credits	4	Course offered year/period	2019/Intensive, year-round
Day/period	Intensive	Class style	Experiment	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,1time,
,9times,
,10times,
,10times,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

未更新

Numbering code			
Course title <English>	機械理工学特別実験及び演習第二 Experiments on Mechanical Engineering and Science,Adv. II	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI

Target year		Number of credits	4	Course offered year/period	2019/Intensive, year-round
Day/period	Intensive	Class style	Experiment	Language	Japanese

[Outline and Purpose of the Course]

[Course Goals]

[Course Schedule and Contents]

,9times,
,10times,
,10times,
,1time,

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

[Textbook]

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	複雑系機械工学基礎セミナー１ Basic Seminar of Complex Mechanical Engineering,1	Affiliated department, Job title,Name	Graduate School of Engineering Professor,HIRAKATA HIROYUKI Graduate School of Engineering Senior Lecturer,SUGIMOTO HIROSHI Graduate School of Engineering Senior Lecturer,AOI SHINYA Graduate School of Engineering Professor,KOMORI MASAHARU

Target year		Number of credits	1	Course offered year/period	2019/First semester
Day/period	Tue.1	Class style	Seminar	Language	English

[Outline and Purpose of the Course]

This seminar provides master-course students an opportunity of face-to-face group discussions to exchange ideas and information with those from other research fields. It is also emphasized in this seminar to give the attendees a chance to boost up the presentation skills necessary to broaden their own expertise across multidisciplinary research fields. The primal aim is to offer these significant experiences of leadership as a young scientist with broad perspective in the global community.

[Course Goals]

Students will be able to acquire presentation and logical thinking skills.

[Course Schedule and Contents]

Self introduction,1-2times,
Organizing groups,1time,
Group activity,10-12times,Each group chooses an activity theme, and pursue the goal through discussion in the group. Weekly reports on the activity are required.
Final presentation,1-2times,Each group gives presentation of its final resutls.

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Based on Group Activity Reports and Personal Report

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

Group activities

（Others (office hour, etc.)）

All activities should be done in English.
Registration is required by the deadline. Contact at
cme-seminar@me.kyoto-u.ac.jp

*Please visit KULASIS to find out about office hours.

Numbering code			
Course title <English>	複雑系機械工学基礎セミナー２ Basic Seminar of Complex Mechanical Engineering,2	Affiliated department, Job title,Name	Graduate School of Engineering Professor,KUROSE RYOUICHI Graduate School of Engineering Associate Professor,NAKAJIMA KAORU Graduate School of Engineering Associate Professor,KOUNO DAISUKE Graduate School of Engineering Professor,KOMORI MASAHARU

Target year		Number of credits	1	Course offered year/period	2019/Second semester
Day/period	Thu.1	Class style	Seminar	Language	English

[Outline and Purpose of the Course]

This seminar provides master-course students an opportunity of face-to-face group discussions to exchange ideas and information with those from other research fields. It is also emphasized in this seminar to give the attendees a chance to boost up the presentation skills necessary to broaden their own expertise across multidisciplinary research fields. The primal aim is to offer these significant experiences of leadership as a young scientist with broad perspective in the global community.

[Course Goals]

Students will be able to acquire presentation and logical thinking skills.

[Course Schedule and Contents]

Self introduction,1-2times,
Organizing groups,1time,
Group activity,10-12times,Each group chooses an activity theme, and pursue the goal through discussion in the group. Weekly reports on the activity are required.
Final presentation,1-2times,Each group gives presentation of its final resutls.

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Based on Group Activity Reports and Personal Report

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

[Regarding studies out of class (preparation and review)]

Group activities

（Others (office hour, etc.)）

All activities should be done in English.
Registration is required by the deadline. Contact at
cme-seminar@me.kyoto-u.ac.jp

*Please visit KULASIS to find out about office hours.

Numbering code	G-INF05 63517 LJ10　G-INF05 63517 LJ77		
Course title <English>	統合動的システム論 Theory of Integrated Dynaminal Systems	Affiliated department, Job title,Name	Graduate School of Informatics Professor,OOTSUKA TOSHIYUKI Graduate School of Informatics Associate Professor,SAKURAMA KAZUNORI

Target year	1st year students or above	Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Mon.4	Class style	Lecture	Language	Japanese

Class type	専攻専門科目

[Outline and Purpose of the Course]

本講義では，人間，機械，社会，環境などさまざまな対象を統合した動的システムをモデル化・解析・設計・制御するための方法論として，非線形システムの最適制御問題およびマルチエージェントシステムの理論について講述する．

講義の前半では，最適化の基礎から始め，動的システムの最も望ましい動かし方を見つける最適制御問題の一般的な設定を述べる．そして，必ずしも解析的に最適解が求められない場合の数値解法についても学ぶ．これらは20世紀半ばに発展した比較的古典的な手法であるが，今でも幅広い応用がある．さらに，近年の計算機と数値解法の発展により，複雑な最適制御問題を実時間で数値的に解くことでフィードバック制御を行うという今までに無い制御の枠組みが生まれつつある．本講義では制御における実時間最適化の基本的な考え方とその適用事例を学ぶ．時間が許せば，離散時間系の最適制御についても連続時間系と対比させながら紹介する．

講義の後半では，複数のエージェントの局所的な相互作用をもとに大域的な機能を発現するマルチエージェントシステムの理論について，自然界や人工物の例からはじめて，ネットワーク構造を記述するためのグラフ理論，合意制御の理論と分散最適化などの応用について述べる．

最適制御とマルチエージェントシステムの理論やアルゴリズムは非常に応用範囲が広い．また，制御理論だけでなく数値計算や計算機などさまざまな分野の進歩を活用するという側面もある．最適制御やマルチエージェントシステムと他分野とのつながりを意識すれば専門の如何に関わらず学んだ知識が豊かなものになるだろう．

[Course Goals]

最適制御がさまざまな問題に応用できることを理解し，制御目的に応じた適切なモデルと評価関数，拘束条件を設定し，最適性条件を導出できるようになる．さらに，最適制御問題の数値解法を理解し，実際に数値解を計算できるようになる．また，さまざまな現象や工学的問題がマルチエージェントシステムとして表現できることを理解し，それらのモデルや制御原理を数学的に記述し解析・設計できるようになる．

[Course Schedule and Contents]

１．最適化問題（1回）
評価関数，制約条件
２．関数の最小化（数理計画問題）（2回）
基本的な概念，KKT条件
４．最適制御問題の定式化と最適性条件（2回）
変分，停留条件，動的計画法，最小原理
５．最適制御問題の数値解法（2回）

Continue to 統合動的システム論 (2)↓↓↓

統合動的システム論 (2)

勾配法，ニュートン法
６．数値最適化によるフィードバック制御（1回）
モデル予測制御問題，数値解法，応用例
７．マルチエージェントシステムとは（2回）
マルチエージェントシステムの例，合意制御
８．線形代数，線形システム論の復習（2回）
固有値，スペクトル分解，スペクトル写像定理，ゲルシュゴリンの定理，遷移行列
９．グラフ理論（2回）
グラフの定義，グラフの代数的性質
１０．合意解析（1回）
連続時間マルチエージェントシステムの解析

[Class requirement]

基礎数学 (多変数の微積分，線形代数) の知識を前提とする．また，必須ではないが，学部の制御理論，最適化などを修得しておくことが望ましい．

[Method, Point of view, and Attainment levels of Evaluation]

達成目標についての達成度をレポートによって評価する．

[Textbook]

大塚敏之『非線形最適制御入門』（コロナ社）ISBN:4339033189
東・永原ら『マルチエージェントシステムの制御』（コロナ社）ISBN:4339033227

[Reference books, etc.]

（Reference books）
A. E. Bryson, Jr., and Y.-C. Ho『Applied Optimal Control』（Taylor & Francis）ISBN:0891162283（話題と例題が豊富である．）
R. F. Stengel『Optimal Control and Estimation』（Dover）ISBN:0486682005（幅広い話題を網羅している．）
D. E. Kirk『Optimal Control Theory: An Introduction』（Dover）ISBN:0486434842（最適制御に話題を絞って平易に書かれている．）
嘉納秀明『システムの最適理論と最適化』（コロナ社）ISBN:4339041238（数値解法について詳しい．）
坂和愛幸『最適化と最適制御』（森北出版）ISBN:4627005393（理論について詳しい．）
大塚敏之ほか『実時間最適化による制御の実応用』（コロナ社）ISBN:4339032107（モデル予測制御の数値解法，自動コード生成，応用事例を紹介している．）
M. Mesbahi and M. Egerstedt『Graph Theoretic Methods in Multiagent Networks』（Princeton University Press）ISBN:0691140618（基礎から幅広い応用まで書かれている．）

[Regarding studies out of class (preparation and review)]

教科書に事前に目を通して講義内容の概略を把握してから講義に臨み，講義後は講義ノートの不明点を教科書や質問で確認することが望ましい．レポートでは，授業外に各自で問題設定や数値計算

Continue to 統合動的システム論 (3)↓↓↓

統合動的システム論 (3)

に取り組む.

（Others (office hour, etc.)）

担当者宛の事前予約によって対応する.

*Please visit KULASIS to find out about office hours.

Numbering code	G-INF05 63513 LJ12　G-INF05 63513 LJ10		
Course title <English>	ヒューマン・マシンシステム論 Theory of Human-Machine Systems	Affiliated department, Job title,Name	Graduate School of Informatics Associate Professor,NISHIHARA OSAMU

Target year	1st year students or above	Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Mon.3	Class style	Lecture	Language	Japanese

Class type	専攻専門科目

[Outline and Purpose of the Course]

人間機械系の一例として、人工現実感(VR)システムを取り上げ、ヒトの視覚、聴覚、触力覚、前庭感覚などとこれらに対応するディスプレイ、レンダリング技術、ユーザーの姿勢、動きを検出するセンサ、VRシステムの構築などについて解説する．そこでは、コンテンツとしてのシミュレーション、拡張現実感、テレプレゼンスなどとの関連性に留意する．続いて、ドライビングシミュレータによる実験技術、シミュレーションの対象となる自動車の運転支援システムなどにも触れる．

[Course Goals]

当該の講義内容について基本概念の理解を深めるとともに、レポート課題への対応を通じて、文書を介した表現に慣熟する．

[Course Schedule and Contents]

人工現実感（VR）に関連する諸概念，VRの歴史［1 週］
VRの入力装置（トラッキングセンサ，操作端，プラットフォーム）［2 週］
VRの出力装置（視覚ディスプレイ、聴覚ディスプレイ、ハプティックディスプレイ、モーションプラットフォーム）
［5 週］
VRにおけるレンダリング（表現手法，レンダリングシステム）［4 週］
自動車の運転支援システム，自動運転（概念と歴史・将来，シミュレーション技術）［2 週］
全体のまとめ（授業内容，期末のレポート作成などに関して受講生からの質問に対応する）[1 週]

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

期末試験またはレポートにより評価する．
講義内容に関する基本知識を習得し、要点を捉え、平易かつ正確に表現していることなどを評価項目とする．特にレポート作成時は、与えられた課題に応じた独自の文献調査が行われ、明解な議論の展開に反映されることを期待する．レポートの出題は複数回となることがある．

[Textbook]

Not used

Continue to ヒューマン・マシンシステム論(2)↓↓↓

ヒューマン・マシンシステム論(2)

[Reference books, etc.]

（Reference books）

William R. Sherman, Alan B. Craig 『Understanding Virtual Reality: Interface, Application, and Design』（Morgan Kaufmann）ISBN:978-1-55860-353-0

舘 暲、佐藤 誠、廣瀬 道孝（監修）『バーチャルリアリティ学』（日本バーチャルリアリティ学会）
ISBN:978-4-904490-05-1

[Regarding studies out of class (preparation and review)]

レポート課題として具体的に指示する．

（Others (office hour, etc.)）

メールアドレス: nishihara@i.kyoto-u.ac.jp

メールによる事前予約の上で面談に応じる．場所は総合研究12号館を予定する．

*Please visit KULASIS to find out about office hours.

Numbering code	G-INF04 63431 LJ55		
Course title <English>	力学系理論特論 Dynamical Systems, Advanced	Affiliated department, Job title,Name	Graduate School of Informatics Professor,YAGASAKI KAZUYUKI

Target year	Master's students	Number of credits	2	Course offered year/period	2019/First semester
Day/period	Tue.2	Class style	Lecture	Language	Japanese
Class type	専攻専門科目				

[Outline and Purpose of the Course]

力学系の知識は数理科学や応用数学の分野において極めて重要なものとなっている．本講義では，分岐およびカオスなどの非線形現象を理解し，解析するための道具である力学系理論を概説し，数値分岐解析ソフトウエアを利用してこれらの現象と応用について理解を深める．

The knowledge of dynamical systems is extremely important in mathematical sciences and applied mathematics. This course provides an outline of dynamical systems theory, which is a tool to understand and analyze nonlinear phenomena such as bifurcations and chaos, and enables you to gain better understandings of these phenomena and applications by using a numerical bifurcation analysis software.

[Course Goals]

力学系の基礎理論を理解し，数値分岐解析ソフトを用いるなどして具体的な問題に応用できるようになること．

To understand fundamental theories of dynamical systems and acquire the ability to apply them to concrete problems.

[Course Schedule and Contents]

1. **力学系理論の概要**
- **分岐** (1)
- **カオス** (1)

2. **数値分岐解析ソフト**AUTO**を用いた演習**
- AUTO**の概要とインストール** (1)
- **境界値問題** (1)
- **平衡点と不動点の分岐** (2)
- **周期軌道の分岐** (2)
- AUTO**で用いられている数値解析手法**(2)
- **ホモクリニック軌道** (2)
- **不変多様体** (3)

1. Outline of dynamical systems theory
- Bifurcations (1)
- Chaos (1)

2. Practices of numerical bifurcation analysis by the software AUTO
- Overview of AUTO and its installation (1)

Continue to 力学系理論特論(2)↓↓↓

力学系理論特論(2)

- Boundary value problems (1)
- Bifurcations of equilibria and fixed points (2)
- Bifurcations of periodic orbits (2)
- Numerical analysis methods used in AUTO (2)
- Homoclinic orbits (2)
- Invariant manifolds (3)

[Class requirement]

微積分，線形代数，微分方程式とコンピュータープログラミングの初歩

Calculus, Linear Algebra, Differential Equations and Elementary Computer Programming

[Method, Point of view, and Attainment levels of Evaluation]

達成目標についての達成度をレポートを含む平常点により評価し，情報学研究科成績評価規定第7条による成績評価を行う

[Textbook]

プリントを配布

[Reference books, etc.]

（Reference books）

J. Guckenheimer，P. Holmes 『Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields』（Springer）ISBN:978-0-387-90819-9
J.M. Meiss 『Differential Dynamical Systems』（SIAM）ISBN:978-0-89871-635-1
S. Wiggins 『Introduction to Applied Nonlinear Dynamical Systems and Chaos 』（Springer）ISBN:978-0-387-00177-7
K.T.**アリグッド**/T.D.**サウアー**/J.A.**ヨーク** **『カオス第1巻』（丸善出版）**ISBN:978-4-621-06542-6
K.T.**アリグッド**/T.D.**サウアー**/J.A.**ヨーク** **『カオス第2巻』（丸善出版）**ISBN:978-4-621-06543-3
K.T.**アリグッド**/T.D.**サウアー**/J.A.**ヨーク** **『カオス第3巻』（丸善出版）**ISBN:978-4-621-06540-2
M.W.Hirsch, S. Smale, R.L.Devaney **『力学系入門―微分方程式からカオスまで― 原著第3版』（共立出版）**ISBN:978-4-320-11136-3

（Related URLs）

http://indy.cs.concordia.ca/auto/(**数値分岐解析ソフトウェア**AUTO)

[Regarding studies out of class (preparation and review)]

本科目の達成目標に到達するには，講義での学習のほかに予習・復習が必要である

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code	G-ENE03 63316 LJ71		
Course title <English>	熱機関学 Heat Engine Systems	Affiliated department, Job title,Name	Graduate School of Energy Science Professor,ISHIYAMA TAKUJI

Target year	Master's students	Number of credits	2	Course offered year/period	2019/Second semester

Day/period	Tue.3	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The aim of this lecture is to understand the measures for improving thermal efficiency and exhaust emissions of reciprocating internal combustion engines such as gasoline, diesel and gas engines. For this end, this lecture describes thermodynamic theories for the in-cylinder processes and fundamental ideas for higher thermal efficiency, less harmful matters' emission and utilization of alternative fuels.

[Course Goals]

To understand the factors for the thermal efficiency and power output and the formation mechanisms for harmful matters based on fundamental knowledge of thermodynamics and chemistory. To obtain the idea for improving combustion applying basic understanding of combustion processes in spark- and compression-ignition engines.

[Course Schedule and Contents]

In principal, the lecture will be offered as follows. However, it may change the order or the number of times for each theme depending on the progressive of the lecture.

1.Introduction
Principle, affects and problems of internal combustion engines [1 week]
2.Definitions of terms
Definitions of important terms regarding thermal efficiency, power, exhaust emissions [1 week]
3.Analysis of thermodynamic cycle
Methods of analysis and factors for thermal efficiency [2 weeks]
4.Methods for higher thermal efficiency
Basic strategies and practical methods [2 weeks]
5.Combustion control 1
Relation between thermal efficiency and exhaust emissions. Needs for combustion control [1 week]
6.Combustion control 2
Current fuels and their influences on engine performance
7.Combustion control 3
Combustion processes and improvement of thermal efficiency and exhaust eissions for spark-ignition engines [2-3 weeks]
8.Combustion control 4
Combustion processes and improvement of thermal efficiency and exhaust eissions for compression-ignition engines [2-3 weeks]
9.Alternative fuels
Topics of alternative liquid and gas fuels [1 week]】
10.Summary
Overview of contents of the lecture, especcialy of important issues. [1 week]

Continue to 熱機関学(2)↓↓↓

熱機関学(2)

[Class requirement]

Fundamental kowledge of thermodynamics is necessary.

[Method, Point of view, and Attainment levels of Evaluation]

Evaluation will be based on attendance(30%) and examination(70%).

[Textbook]

Handouts

[Reference books, etc.]

（Reference books）

To be announced in class if necessary.

[Regarding studies out of class (preparation and review)]

To be announced in the class.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code	G-ENE03 63322 LJ71				
Course title <English>	燃焼理工学 Combustion Science and Engineering		Affiliated department, Job title,Name	Graduate School of Energy Science Professor,KAWANABE HIROSHI Graduate School of Energy Science Associate Professor,Jun HAYASHI	
Target year	Master's students	Number of credits	2	Course offered year/period	2019/First semester
Day/period	Tue.1	Class style	Lecture	Language	Japanese

[Outline and Purpose of the Course]

The fundamentals of combustion science are lectured, such as burning velocity, ignition, thermodynamics and emission formation. Furthermore, flame structure and stability of laminar and turbulent flames and combustion process of liquid fuels are mentioned.

[Course Goals]

Understanding the following;
(1) Combustion process in thermal power systems
(2) Physical and chemical processes in a combustion
(3) Design and control methodologies of combustion for engineering applications

[Course Schedule and Contents]

(1) Chemistry Fundamentals, Properties of substance
Quantum mechanics, Atomic system, Atomic structure and reactivity of oxygen, Atomic-atomic bond and molecular structure
(2) Combustion chemistry
Chemical reaction and reaction rate, Rate constant, Activation energy
(3) Combustion reaction process
Auto-ignition process, Flash phenomenon and flash point, Flammable limit, Minimum ignition energy and quenching distance
(4) Oxidation of gas fuel
Hydrogen, Carbon oxide, Hydrocarbon fuels
(5) Thermodynamics of combustion
Stoichiometry, Heat of reaction, Equilibrium, Adiabatic flame temperature
(6) Combustion product
Formation process of nitrogen oxide, soot and radical species
(7) Premixed flame
Deflagration and detonation, Structure of laminar flame, Flame speed, Flame stability, Turbulent premixed flame
(8) Diffusion flame
Jet diffusion flame, Laminar diffusion flame, Turbulent diffusion flame
(9) Liquid fuel
Evaporation of droplet, Spray combustion
(10) Combustion diagnostics
Temperature, Pressure, Velocity, Flow rate, Gas composition

Continue to 燃焼理工学(2)↓↓↓

燃焼理工学(2)

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

Evaluate by attendance and report(s).

[Textbook]

Not used

[Reference books, etc.]

（Reference books）

Introduced during class

[Regarding studies out of class (preparation and review)]

Instruct in class.

（Others (office hour, etc.)）

*Please visit KULASIS to find out about office hours.

Numbering code	G-LAS00 80001 LJ20		
Course title <English>	研究倫理・研究公正（理工系） Research Ethics and Integrity(Science and Technology)	Affiliated department, Job title,Name	Institute for Liberal Arts and Sciences Program-Specific Professor,ITO SHINZABUROU Institute for Liberal Arts and Sciences Program-Specific Professor,SATOU TOORU Graduate School of Engineering Professor,KAWAKAMI YOUICHI

Group	Common Graduate Courses	Field(Classification)	Social Responsibility and Profitability

Language	Japanese	Old group		Number of credits	0.5

Hours	7.5	Class style	Lecture	Course offered year/period	2019・ Intensive, First semester

Day/period	Intensive	Target year	Graduate students	Eligible students	For science students

[Outline and Purpose of the Course]

研究をこれから始める大学院生に責任ある行動をする研究者として身につけておくべき心構えを講述する。研究者としての規範を保っていかに研究を進めるか、また研究成果の適切な発表方法など、研究倫理・研究公正についてさまざまな例を示しながら、科学研究における不正行為がいかに健全な科学の発展の妨げになるか、またデータの正しい取扱いや誠実な研究態度、発表の仕方が、自らの立場を守るためにもいかに重要かを講義する。さらに、研究費の適切な使用と知的財産や利益相反について学ぶ。講義に続いてグループワークを行い、与えられた仮想課題を自らの問題として考え、解決方法のディスカッションを行う。

[Course Goals]

第１講～第４講を通じて、研究者としての責任ある行動とは何かを修得する。科学研究における不正行為の事例学習、討論を通じて、誠実な研究活動を遂行する研究者の心得を身につけ、最後に研究倫理・研究公正についてのe-ラーニングコースを受講し、理解度を確認する。

[Course Schedule and Contents)]

第１講　科学研究における心構え－研究者の責任ある行動とは－
１．研究者の責任ある行動とは（学術活動に参加する者としての義務）
２．不正の可能性と対応
３．実験室の安全対策と環境への配慮
４．データの収集と管理－実験データの正しい取扱い方－
５．科学上の間違いと手抜き行為の戒め
６．誠実な研究活動中の間違いとの区別
７．科学研究における不正行為
第２講　研究成果を発表する際の研究倫理公正
１．研究成果の共有
２．論文発表の方法とプロセス
３．科学研究における不正行為（典型的な不正）
４．データの取扱い（データの保存・公開・機密）
５．その他の逸脱行為（好ましくない研究行為）
６．研究不正事件（シェーン捏造事件）
７．不適切な発表方法（オーサーシップ、二重投稿）
第３講　知的財産と研究費の適正使用
１．知的財産の考え方（知的財産の確保と研究発表）
２．研究資金と契約

Continue to 研究倫理・研究公正（理工系）(2)↓↓↓

研究倫理・研究公正（理工系）(2)

３．利益相反（利害の衝突と回避）
４．公的研究費の適切な取扱い
５．研究者・研究機関へのペナルティー
６．事例紹介（ビデオ：分野共通４件）
７．結語
第４講　グループワーク
１．例示された課題についてグループ・ディスカッションと発表
２．日本学術振興会「研究倫理ラーニングコース」の受講と修了証書の提出

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

第１～４講の全てに出席と参加の状況、ならびに学術振興会e-learningの修了証の提出をもって合格を判定する。

[Textbook]

日本学術振興会「科学の健全な発展のために」編集委員会 『科学の健全な発展のために－ 誠実な科学者の心得－』（丸善出版）ISBN:978-4621089149（学術振興会のHP（https://www.jsps.go.jp/j-kousei/data/rinri.pdf）より、テキスト版をダウンロード可能）

[Reference book, etc.]

（Reference book）
米国科学アカデミー 編、池内 了 訳 『科学者をめざす君たちへ―研究者の責任ある行動とは』（化学同人）ISBN:978-4759814286
眞嶋俊造、奥田太郎、河野哲也編著 『人文・社会科学のための研究倫理ガイドブック』（慶応義塾大学出版会）ISBN:978-4766422559
神里彩子、武藤香織編 『医学・生命科学の研究倫理ハンドブック』（東京大学出版会）ISBN:978-4130624138
野島高彦著 『誰も教えてくれなかった実験ノートの書き方』（化学同人）ISBN:978-4759819335
須田桃子著 『捏造の科学者 STAP細胞事件』（文藝春秋）ISBN:978-4163901916

[Regarding studies out of class (preparation and review)]

日本学術振興会「研究倫理ラーニングコース」の受講

[Others (office hour, etc.)]

第１～３講は土曜２，３，４限に行う。第４講はグループワークを中心として講義の翌週または翌々週の土曜１，２または３，４限に実施する。

Numbering code	G-LAS00 80004 LJ44		
Course title <English>	知的財産 Intellectual Property	Affiliated department, Job title,Name	Office of Society-Academia Collaboration for Innovation Endowed Research Professor,KITANI TETSUO Office of Society-Academia Collaboration for Innovation Project Professor,KAWABATA TADASHI
Group	Common Graduate Courses	Field(Classification)	Social Responsibility and Profitability
Language	Japanese	Old group	Number of credits: 0.5
Hours	7.5	Class style	Lecture
Course offered year/period	2019・ Intensive, First semester		
Day/period	Intensive	Target year	Graduate students
Eligible students	For all majors		

[Outline and Purpose of the Course]

経済活動を支える手段として「知的財産」「知的財産権」（以下まとめて「知財」という。）は重要なファクターとなっている。
　「知財」は、ライバル企業による模倣の制止（侵害訴訟）だけでなく、企業間の協力（ライセンス、パテント・プール）、研究開発力向上（職務発明制度）などの面で利用され、企業の競争力を高めるための手段として活用されている。また、大学も例外でなく、その研究成果の社会実装に向けて、企業との共同研究、ベンチャー企業育成などに取り組んでいるが、こうした活動において「知財」ルールをうまく取り決めないと将来の研究活動に制限をうけるリスクが生じる。
　本授業では、「知財」についての基本的知識とともに、企業や大学の具体的な活動事例に基づきながら、「知財」の活用方法についての考え方を習得することを目的とする。

　※「知的財産」とは、（１）発明、考案、植物新品種、意匠、著作物など、人間の創造的活動により生み出されるもの、（２）商標、商号その他の事業活動に用いられる商品または役務を表示するもの、および（３）営業秘密その他の事業活動に有用な技術上または営業上の情報をいう。
　※「知的財産権」とは、特許権、実用新案権、育成者権、意匠権、著作権、商標権その他の知的財産に関して法令により定められた権利または法律上保護される利益に係る権利をいう。

[Course Goals]

本講座では、
①知的財産の概要
②知財戦略の基本的な考え方
③企業、ベンチャーや大学における知財活用（取り組み事例）
④権利取得や知財契約の種類と考え方
⑤先行技術情報検索手法についての基礎的な知識
の習得を目的とする。

[Course Schedule and Contents)]

①知的財産の概要
②知財戦略の基本的な考え方
③企業、ベンチャーや大学における知財活用（取り組み事例）
④権利取得や知財契約の種類と考え方
⑤先行技術情報検索手法についての基礎的な知識

上記①から⑤について、全４回で授業する。

そのほか、必要に応じて、以下を行う。

Continue to 知的財産(2)↓↓↓

知的財産(2)

・専門家（弁護士、企業知財担当者など）を招へいし、特許戦略や特許訴訟など企業の具体的取組事例を紹介
・京都大学における産学連携の取組、知財活動を紹介。

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

レポート：60%
平常点評価（出席状況）：40%

[Textbook]

Not fixed

[Reference book, etc.]

（Reference book）
Introduced during class

[Regarding studies out of class (preparation and review)]

特になし

[Others (office hour, etc.)]

授業中に紹介する