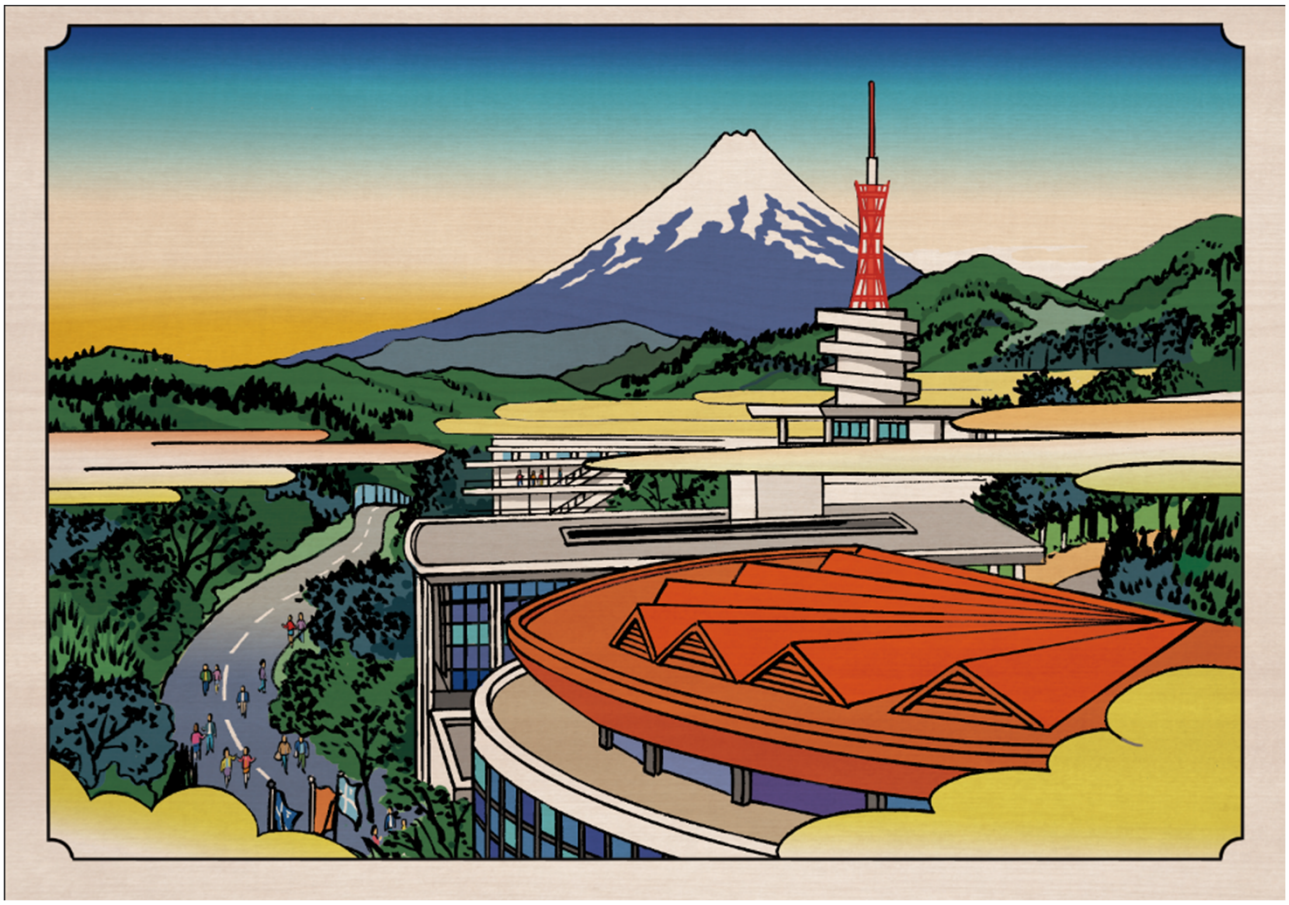
TOKAI

Tokai University



2019

Master’s classes taught in English

TOKAI UNIVERSITY

Courses taught in English

Graduate School of Engineering [2019 Spring Semester]

Day	Period	Grade No.	Course No.	Credit	Subject	Professor
Mon	1	500	Z45181	2	EEE ADVANCED PRACTICE 1	TAKESHITA SHU
Mon	3	600	Z43803	2	COMPRESSIBLE FLUID DYNAMICS	TAKAKURA YOKO
Mon	4	600	Z42564	4	LECTURES AND EXERCISES ON APPLIED HYDRAULICS	YAMAMOTO YOSHIMICHI
Tue	2	600	Z43854	2	COMBUSTION ENGINEERING	AZETSU AKIHIKO
Tue	2	600	Z42840	2	ARCHITECTURAL PROFESSION	WATANABE KENJI
Tue	3	600	Z45687	2	BIOLOGICAL AND COMPUTATIONAL LEARNING SYSTEM	OZEKI TOMOKO
Tue	3	600	Z43811	2	PRECISION MACHINING	TSUCHIYA KAZUYOSHI
Tue	4	600	Z41371	2	RESOURCES AND ENERGY	KANIE OSAMU
Wed	1	600	Z42726	2	MATERIAL SCIENCE	KASAI TETSURO
Wed	1, 2	600	Z42947	4	LECTURES AND EXERCISES ON NONSTRUCTURAL MATERIALS	YOKOI TAKESHI
Wed	2	600	Z45075	2	PHOTOCHEMISTRY	MAEDA SHUICHI
Wed	2	600	Z45156	2	NEUROINFORMATICS	TAKAO MOTOHARU
Wed	4	600	Z45172	2	CONTROL ENGINEERING	INABA TAKESHI
Wed	5	500	Z43838	2	BASIC MECHANICAL ENGINEERING A	TAKAHASHI SHUN
Thu	1	600	Z43943	2	MULTIBODY DYNAMICS	KOGANEZAWA KOICHI
Thu	2	600	Z41380	2	POLYMER CHEMISTRY	NAGASE YU
Thu	3	600	Z45229	2	ELECTRICAL CIRCUITS	SHOW YOSHIYUKI
Fri	1	500	Z44907	2	TECHNICAL ENGLISH FOR ENGINEERS	BAILEY RICHARD et al
Fri	2	600	Z41690	2	MATERIAL CHEMISTRY	OKAMURA YOSUKE
Fri	4	600	Z45261	2	BASIC ELECTROMAGNETICS	KURODA KAGAYAKI
Sat	2	600	Z42564	4	LECTURES AND EXERCISES ON APPLIED HYDRAULICS	TADA TSUYOSHI
TBD				2	RESEARCH SEMINAR	ALL PROFESSORS

TOKAI UNIVERSITY

Courses taught in English

Graduate School of Engineering [2019 Fall Semester]

Day	Period	Grade No.	Course No.	Credit	Subject	Professor
Mon	1	600	Z45768	2	ADVANCED ELECTROMAGNETIC	OHYAMA RYUICHIRO
Mon	1	600	Z48708	2	STRENGTH OF MATERIALS	WUNDERLICH WILFRIED
Mon	3	600	Z40073	2	REMOTE SENSING	CHO KOHEI
Mon	3	600	Z48716	2	TOPICS IN NUCLEAR ENGINEERING	MICHIAKI UTSUMI, ITO ATSUSHI, YASUHISA IKEDA
Mon	3	600	Z49135	2	NUMERICAL ANALYSIS OF COMPRESSIBLE FLUID	TAKAKURA YOKO
Mon	3	600	Z48791	2	MATHEMATICAL STATISTICS	TSUCHIYA KAZUYOSHI
Mon	4	600	Z48970	2	MECHANICAL DYNAMICS	YAMAMOTO YOSHIO
Tue	1	600	Z49950	2	ENGLISH RESENTATION FOR ENGINEERS	SHROSBREE Mark et al.
Tue	2	600	Z40162	2	SEMICONDUCTOR PHYSICS	ISOMURA MASAO
Tue	2	600	Z47604	2	ARCHITECTURAL SPACE PLANNING	SOGAME AKITO
Tue	4	600	Z46381	2	ADVANCED ENERGY CONVERSION SCIENCE	YOSHIHITO MATSUMURA
Tue	5	600	Z46381	2	ADVANCE COURSE ON CERAMIC MATERIALS	MATSUSHITA JUNICHI
Wed	1	600	Z40065	2	VIRTUAL REALITY	HAMAMOTO KAZUHIKO
Wed	1	600	Z47710	2	URBAN DEVELOPMENT SYSTEM	KAJITA YOSHITAKA
Wed	2	600	Z40111	2	ANALOG ELECTRONICS	MAGATANI KAZUSHIGE
Wed	3	600	Z46349	2	APPLIED MATERIALS PROCESSING	WUNDERLICH WILFRIED
Wed	3	600	Z47736	2	ARCHITECTURAL PASSIVE SYSTEM	TAKAHASHI ITARU
Wed	5	500	Z48830	2	BASIC MECHANICAL ENGINEERING B	YOSHINAGA MASASHI
Thu	1	600	Z49089	2	ADVANCED ROBOTICS	YAMAMOTO YOSHIO
Thu	1,2	600	Z47809	4	ARCHITECTURAL DESIGN STUDIO 2	KOCHI KAZUYASU
Thu	2	500	Z40154	2	EEE ADVANCED PRACTICE 2	MIZUTANI KENJI
Thu	2	600	Z49046	2	AERONAUTICAL ENGINEERING	MIZUKAKI TOSHIHARU
Thu	3	600	Z49071	2	SPACE SYSTEMS ENGINEERING	FUKUDA KOTA
Thu	4	600	Z49194	2	STRENGTH OF MATERIALS	MORIYAMA HIROYUKI
Fri	2	600	Z47914	2	SPECIAL EXERCISE ON STRUCTURAL MATERIALS	WATANABE KEN
Fri	3	600	Z40057	2	ROBOTICS SIMULATION	INAGAKI KATSUHIKO
Fri	3	600	Z46365	2	CHEMICAL THERMODYNAMICS	SATO MASASHI
Fri	4	600	Z49909	2	ENGINEERING ETHICS AND INTELLECTUAL PROPERTY	ASOBE MASAKI et al.
Fri	4	600	Z47931	2	COASTAL HYDRAULICS	YAMAMOTO YOSHIMICHI
TBD				2	RESEARCH SEMINAR	ALL PROFESSORS

Courses taught in English

Graduate School of Science

[2019 Spring Semester]

Day	Period	Grade No.	Course No.	Credit	Subject	Professor
Mon	2	500	Z41550	2	CHEMISTRY OF PHOTOFUNCTIONAL MATERIALS	TOMITA Koji
Mon	2	500	Z41011	2	Elementary Particle Theory 1	KITABAYASHI Teruyuki
Mon	4	500	Z41045	2	POLYMER PHYSICS 1	KITA Rio
Tue	3	500	Z41151	2	DYNAMICS IN COMPLEX LIQUIDS 1	SHINYASHIKI Naoki
Wed	1	500	Z41711	2	EDUCATIONAL CHEMISTRY 2	ITO Takeru
Thu	3	500		2	Algebra	TAKI Shingo
Fri	2	500	Z42700	2	ANALYTICAL CHEMISTRY 2	MIKAMI Ikko
Fri	3	500	Z43188	2	LECTURE ON STATISTICAL MECHANICS1	YAMAGUCHI Makoto

[2019 Fall Semester]

Day	Period	Grade No.	Course No.	Credit	Subject	Professor
Thu	1	600	Z46802	2	ANALYSIS D	UEKI Seiichiro
Thu	2	500	Z47981	2	ORGANIC CHEMISTRY	KOGUCHI Shinichi
TBD		600		2	Discrete Mathematics B	MATSUI Yasuko

Courses taught in English

Graduate School of Information and Telecommunication Engineering

[2019 Spring Semester]

Day	Period	Grade No.	Course No.	Credit	Subject	Professor
Mon	3	600	910406	2	COMPUTER ENGINEERING	SHIMIZU Naohiko
Tue	2	600	910953	2	Web Information Retrieval	FUJINO Iwao

[2019 Fall Semester]

No class

2019

Graduate School of Engineering

Subjects taught in English

*Class schedule is subject to change

Spring Semester

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	1	電気電子工学特別演習１	EEE ADVANCED PRACTICE 1	TAKESHITA SHU	2

「電気電子工学特別演習１」は「電気電子工学特別演習２」とあわせ，工学研究科・電気電子工学専攻において必要となる数学的基礎知識を附与するものである．「電気電子工学特別演習１」においては，微積分，ベクトル解析，函数変換の３テーマについて学習する．また「電気電子工学特別演習２」では線形代数，複素函数，確率統計について学習する．両者をあわせて電気電子工学専攻における各種専門科目および修士論文における理論的基礎を涵養することを目的とする．もとより本特別演習が対象とする数学的基礎は学部授業で基礎的な内容は履修済みである．しかしながらより高度な専門科目への応用，また修士論文における独創的応用を目指すものとすれば，表層的な知識にとどまらず，なぜそのような数学が必要か，また種々の命題の裏に潜む数学的思想を納得しなければならない．また自分の研究に応用するためには，教科書を理解するだけではなく，新たな問題に応用してその知見を駆使できなければならない．この目的を達成するために，本特別演習では講義とともに各種の演習を課す．演習の形態は講義内容に応じて，紙上，板書による命題の導出，証明の演習から，コンピュータ上のシミュレーション演習まで種々工夫される．本演習を効果的に進めるため，本特別演習では履修者を３グループに分け，少人数のクラスで講義演習を運用する．各テーマ 4 回の講義演習について各担当教員の指導を受けるものとする．３つのテーマを 4 回ずつ計 12 回の講義演習をもって履修完了とする．

各講義演習に予習・復習を課す．授業スケジュールに示す各回の講義演習内容について前もって指定される教科書・資料あるいは各自の資料，図書館資料等を調べ，あらかじめ疑問点等を把握しておくことを課す．復習としては，講義演習で納得できなかった箇所のフォローアップを課す．疑問が残れば，次回の授業で質問することを勧める．各講義における演習および宿題等は採点して返却する．

“Electrical and Electronic Engineering Advanced Practice 1 (EEE Advanced Practice 1)” and “Electrical and Electronic Engineering Advanced Practice 2 (EEE Advanced Practice 2)” provides basic mathematical knowledge to cultivate theoretical foundations in various specialized subjects and master thesis. In EEE Advanced Practice 1, students will learn about calculus, vecter analysis, and function transformation. This lecture imposes various exercises depending on the content of the lecture, along with lectures. In order to advance this lecture effectively, students are divided into three groups and have lectures in a small class. Each instructor will give guidances on the 4 lectures and exercises for each theme. The whole 12 classes will be completed by taking 3 themes which are composed of 4 lectures. Students are required to check the textbooks / materials specified in advance or their own materials, library materials, etc. for the contents of each lecture / exercise shown in the class schedule, and to grasp any questions in advance. If you have any questions, we recommend that you ask questions in the next class.

Spring

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	3	圧縮性流体力学特論	COMPRESSIBLE FLUID DYNAMICS	TAKAKURA YOKO	2

圧縮性流体の流れは，衝撃波・膨張波の発生や流体の温度変化など，非圧縮性流れにはない特有の現象を伴います。特に工学分野に着目すると，航空機，ロケット，高速列車のような高速物体まわりの外部流や，タービン，ジェットエンジン，エンジンシリンダや排気管，ガス配管などにおける高速の内部流において，圧縮性流れが生じます。圧縮性流体の特徴と現象を理解することは，上記の移動物体やエンジンシステム，電力プラントの研究開発，設計，作動運転に必要不可欠です。

本科目では，圧縮性流体力学について，熱力学，一次元流れの基礎式と波動現象，二次元超音速流中の衝撃波・膨張波，多次元流れの基礎方程式，摩擦を伴う流れとその性質などを重点的に扱い，あわせて演習問題を行い理解を確実にします。

Flows of compressible fluids are accompanied by characteristic phenomena such as generation of shock and expansion waves and change of temperature, which do not emerge in incompressible flows. In the engineering fields, among all, the compressible flows are observed in the external flows about high-speed vehicles such as airplanes, rockets and bullet trains, and in the internal high-speed flows inside turbines, jet engines, engine cylinders with intake and exhaust ducts, and gas-piping systems, etc. To understand the properties and phenomena of compressible fluids is inevitable on the research and developments, design, and operation of the above stated vehicles, engine system, and power plants.

In this subject about the compressible fluid dynamics, thermodynamics, basic equations and wave motion of one-dimensional flows, two-dimensional supersonic flows with shock and expansion waves, governing equations of multi-dimensional flows, flows with friction and their properties are stressed on. Moreover exercises will lead you to solid understandings.

Spring

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	4	応用水理学特論・同演習	LECTURES AND EXERCISES ON APPLIED HYDRAULICS	YAMAMOTO YOSHIMICHI	4

水理学は，治水対策・利水対策を考える上で要（かなめ）となる学問です．したがって，土木工学を専攻する学生に是非とも習熟してもらわなければならない重要な科目のひとつです．応用水理学特論では，河川や海岸で生じる非定常の流体現象を偏微分運動方程式等を使って解明する方法を学習します．さらに、これらを人に教えられる力も付けます．このための能力向上法として，アクティブラーニング（ディスカッション，プレゼンテーション等）を採用しております．

Hydraulics is the science necessary to examine flood control and irrigation. Therefore, Advanced Hydraulics is the subject which students who specialize in Civil Engineering should master by all means. In Advanced Hydraulics, you learn some methods for elucidating unsteady phenomena which occur in rivers and seas using partial differential equations. Moreover, let's raise your ability so that you can teach them to other persons. We have adopted Active Learnig (discussion, presentation, etc.) to raise your capability..

Spring

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	2	燃焼工学特論	COMBUSTION ENGINEERING	AZETSU AKIHIKO	2

燃焼とは化学反応、熱の発生、熱の伝達、流れなどが互いに複雑に絡み合った現象です。ボイラや、自動車エンジン内の燃焼では、燃料が空気により急激に酸化され、高温の燃焼ガスとなります。このように、燃料を燃焼させることによって燃料が持っている化学エネルギを熱エネルギに変換します。ガソリン機関やガスタービン等の動力機械はこの熱エネルギを利用しています。このように、私達は燃焼により得られる熱エネルギの恩恵を受けていますが、一方、人口増加、経済成長、エネルギー消費の増大に伴って大量の燃料を燃焼した結果、燃焼に伴い発生する炭酸ガス等温室効果ガスによる地球温暖化、窒素酸化物や硫黄酸化物の排出による酸性雨の問題等が私達の生活に大きな脅威を与えつつあります。

本講義ではこのような問題に対応するために必要な、燃焼現象の基本を理解することを目的としています。なお講義は原則として英語により行います。

Advanced Lecture on Combustion Engineering

Combustion is a very complex phenomenon governed by thermodynamics, fluid dynamics, chemistry and more. This phenomenon is utilized in many machines such as boilers, engines for automobiles and ships, jet engines, gas turbines. Therefore to improve the performance of these machines and to solve the environmental problems, the knowledge of combustion is very important.

This lecture is aimed to give the basic and fundamental knowledge of combustion and to foster the ability for studying advanced topics by themselves.

Spring

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	2	建築家職能特論	ARCHITECTURAL PROFESSION	WATANABE KENJI	2

本講義では、近代においてどのように建築家の職能が成立したのかを、イギリスと日本における歴史を振り返りながら、時代背景と文化的コンテクストを踏まえた上で、建築家職能団体の成立並びに建築教育制度を検証する。具体的には 19 世紀イギリスにおける RIBA 及び AA の成立過程と資格試験制度の確立に至る経緯、同様に、明治時代における工部大学校造家学科と日本建築学会の成立へのイギリスからの影響を理解する。さらに 1920 年代から 30 年代にかけての建築教育のモダニズム建築に対応するための変化や職能上の問題点を考える。最終的には近代建築・都市環境の保存や再生に関する建築家職能の可能性と問題点を検証し、将来における職能の姿を議論する。

This lecture will be focused on the issues of modern architectural profession, especially in the case of Britain and Japan from the 19th to the 21st century. First of all, the students look back the history of these countries, including social and cultural context, they should discuss the reason in which architectural professional organization such as RIBA (Royal Institute of British Architects) and AA (Architectural Association) established and related to the architectural education system. Second part of this lecture, the students should have presentation to propose the historical investigation for transformation architectural profession from pre-modern to modern system in each countries where they chose. Finally, this lecture will conclude any diversity of architectural profession including conservation and renovation for modern architecture.

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	3	生命情報学習特論	BIOLOGICAL AND COMPUTATIONAL LEARNING SYSTEM	OZEKI OMOKO	2

In this lecture, I will explain machine learning methods and the theory of neural networks, especially deep learning which mimics the human brain and solves problems that humans solve intuitively such as recognition of faces, facial expressions, voice, natural language processing, and so on.

Recently, because of the development of hardware and the availability of large amount of data, machine learning techniques can be applied to real world problems. On top of that, various free softwares are provided on the internet and anyone can apply various machine learning techniques to his own data just by preparing high-performance computers, especially GPUs, without knowing what the computer or software is doing. However, it is important to know the theoretical details of algorithms. The theories of machine learning techniques include mathematics which is not easy. I will explain the theory of machine learning from fundamental mathematics to advanced techniques.

Spring

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	3	精密加工学特論	PRECISION MACHINING	TSUCHIYA KAZUYOSHI	2

技術者の最大重要目的は，物を設計することである．機械主要部品あるいは機械の設計をする上での重要な要素は，(1)機械的特性を含む材料の知識，(2)構造設計，(3)加工方法である．現在，技術の進歩に伴う新材料の創製技術の開発，およびナノ・マイクロオーダでの加工精度の向上によるマイクロマシンの創製が実現しようとしている．本特論は，マイクロマシン用アクチュエータ，およびセンサにおけるマイクロ加工技術について言及し，特に形状記憶合金，圧電材料の創製技術について適用事例を通じて深く述べる．さらには，高度な技術レベルをもつ日本の技術者にとって，国際標準言語である英語での技術英語能力を身に付けることが必須となっている．本特論では機械技術者を対象とした英語による講義を行う．

The engineer's important aim is to design products including the parts of it. The important elements in designing machine main parts or machines are (1) knowledge of materials including mechanical properties, (2) structural design, and (3) processing methods. Currently, we are trying to develop new materials creation technology and to create micromachines by improving processing accuracy in nano / micro order. This special issue refers to micromachining technology for microactuators and microsensors, and particularly describes the creation technology of shape memory alloys and piezoelectric materials through application examples.

Spring

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	4	資源・エネルギー特論	RESOURCES AND ENERGY	KANIE OSAMU	2

In this lecture, we consider the possible actions for establishing a sustainable structure of our society. For this purpose, we study the past and the current situation highlighting resources and energy. Raising problems and making actions try to solve the problems have to be always based on the evidence that had already occurred. This is prime importance for every parts of science.

First, we learn how the human society dealt with energy and resources in the past and how the situation changed. We also learn some relationship of issues of energy and resources with secondary aspect of our society such as the economical aspect. We then discuss the possible actions in an aspect of energy and resources for our sustainable society, which relates to continuation of existence of human species.

Spring

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	1	材料科学特論	MATERIAL SCIENCE	KASAI TETSURO	2

建設系の構造材料には、この性質、形態、性能などの異なる多種多様なものが使用され、また、その使用目的や使用時期・段階によって考慮すべき性質が異なっている。このため、材料の開発・設計及び材料の選択・適用をより合理的に行うためには、基礎となる材料の性質を普遍的・体系的に理解することが大切である。

本講では、材料の状態を液体、半固体及び固体に分類し、各状態における材料学的性質の考え方とその解析法について、鋼材、コンクリート、ガラス、プラスチックなどの主要建設材料を例に挙げ説明する。

(The constructional materiasl are used various matters which differs in character, performance, and etc. .Moreover, the character which should be taken into consideration by the used purpose and time differs.

For this reason, in order to perform development of material, and a design and selection of material rationally, it is important to understand the character of the material used as the foundation universally or systematically.

In this lecture, the condition of material is classified into a liquid, a semi-solid, and a solid, and about the method of view and analytic on the material science in each condition, main construction materials, such as steel, concrete, glass, and a plastic, are explained.)

Spring

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	1, 2	建築非構造材料特論・同演習	LECTURES AND EXERCISES ON NONSTRUCTURAL MATERIALS	YOKOI TAKESHI	4

建築材料を学ぶうえで、構造材料のみを議論されがちである。しかし、仕上げ材料は、建築物使用者が常に直接触れるため、日常生活の安全性と快適性に大きく影響する。したがって設計時に仕上げ材料を選定するためには、使用者の判断，評価に基づく性能の概念が非常に重要になる。この講義では、以下の 3 つの主題を論じる。 ・使用者の判断，評価に基づく性能設計の概念 ・性能に基づいた仕上げ材の合理的な選定方法 ・工法と性能の関係

In building material studies, it tends to be paid attention to structural materials. But finishing materials greatly influence safety and comfortablety in daily life. Because those are always touch human directly. Moreover, when designing finishing materials, the concept of performance based on users' sense becomes very important. Main topics given in this lecture is 3 of the following. -Concept of performance design of finishing materials based on users' sense -Reasonable selection technique of finishing materials based on performance -Relation between construction method and performance

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	2	光化学特論	PHOTOCHEMISTRY	MAEDA SHUICHI	2

In this lecture, first of all, we review the classical quantum theory. Then, after molecular orbital method, we discuss the interaction between light and materials. Classes are carried out interactively.

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	2	神経情報科学特論	NEUROINFORMATICS	TAKAO MOTOHARU	2

ニューロコンピューティングやブレイン-マシン-インタフェースの技術開発に代表されるように、情報科学と神経科学は近年密接に関わっており、お互いの研究知見や技術を取り込みつつ相補して発展している。そのため、情報科学を学ぶ学生が次世代の IT 技術の発展に貢献するために、神経科学の知識は必須だといえる。本講義においては、近年研究上の進歩の著しい神経情報工学分野（神経科学と情報科学との融合分野）の研究紹介を行う。また、受講者各自との議論を通じ、研究成果の工学的応用の方向性について探っていく。

Neurosience has been advanced along with infomration and communication technology. As known in neural network computing and brain-machine interface technologies, these two disciplines still have a strong tie, and must be integrated to make new technological advancements in near future. In my lectures, fundamental neuscience will be taught and its application to information technologies will be discussed with other students.

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	4	制御工学特論	CONTROL ENGINEERING	INABA TAKESHI	2

本講義では，制御系 CAD を用いて制御工学の諸問題を解く手法について学ぶ．前提として，線形代数，ラプラス変換の基礎知識が必要である．まず，制御系 CAD である MATLAB の基本的な使い方を教授する．その上で，動的システムモデルの取り扱い，時間応答の解析，周波数応答の解析，周波数領域における安定性の解析と補償について学ぶ．さらに，状態空間に基づく現代制御理論について教授する．

In this lecture, method of applying MATLAB to the control engineering problems is explained to students.
The students are required to have the knowledge of linear algebra and Laplace transform.
We will begin with introduction to MATLAB, and then expression of dynamical system model, time response analysis, frequency response analysis, stability analysis and compensation of the control system on frequency domain are explained. Moreover, We will treat the modern control theory based on state-space modeling.

Spring

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	5	機械工学特論 A	BASIC MECHANICAL ENGINEERING A	TAKAHASHI SHUN	2

機械工学は、諸産業の中で最も広い分野を占め、あらゆる産業の基礎をなすものです。したがって、機械工学の持つ内容は、他の工学と比較してきわめて広範囲なものとなっています。特に、最近の学術進歩のめざましい発展に伴い、その事実を修得するだけでも時間を必要とします。一般に専門の授業では、理論学説を中心とした講義が多く、演習時間が少ない傾向にあります。本科目では、基礎となる専門知識、さらに表現力、独創性、理論性、判断力などを備えた総合力を学生自身で身につけることを目標としています。そのため本科目では、学部で得た専門基礎知識を復習・整理し、知識を補充し、機械工学専攻の学生にとって必要最低限の知識を身に付けると共に、修士研究の遂行に役立つ情報の提供を目的としています。
機械工学特論 A では熱工学・流体工学領域および機械力学・制御工学領域の専門分野の基礎的事項について理解を確実にし、自己の理解度を評価するために、毎回課題を課し、授業でその課題について説明を行います。よって、学生諸君には、各回とも事前に十分な予習が必要です。また、研究事例を通して応用的な知識も修得する科目です。

Mechanical engineering is widely used for practical engineering and it is addressed as fundamentals of industrial products. That is, the mechanical engineering covers huge areas comparing with other engineering fields. Consequently, we need long time to study it because of the rapid progress of the technologies. However, we have few examinations about the fields though we have many theoretical lectures. In this class, we focus on the fundamentals of the specialty, expression, originality and judgement. The knowledge should be learned by students by themselves in this class. Therefore, the knowledge obtained in bachelor is reviewed and rearranged to utilize it to the master study and thesis. In the class of mechanical engineering A, all the student should make clear about the understanding of the fundamentals of thermodynamics, fluid dynamics, mechanical dynamics and control engineering. For the purpose, we will give homework to do in advance of the lecture. All the students have to finish the homework by yourself in advance and submit. By using the homework, we will give some examples of the answer to understand the fundamentals.

Spring

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	1	マルチボディダイナミクス特論	MULTIBODY DYNAMICS	KOGANEZAWA KOICHI	2

本授業では，ロボットに代表される多体機械システム（Multibody system）の運動学(kinematics) 並びに動力学(dynamics) の一般的解法を習得することを目的とする．３次元空間上の多自由度機械システムを扱うためコンピュータプログラミングを前提とした運動の定式化が必要となる．そのため，本授業では方程式の生成と計算実行が可能な Mathematica を使用する必要がある．

The lecture deals with kinematics and dynamics of multi-body systems represented by robots. Mathematical formulation of the multi-DOF mechanical systems is so complicated that it requires to use a versatile computer programming. So the lecture uses MATHEMATICA for deriving kinematic ore dynamic equations and for solving them in a visual animation.

Spring

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	2	高分子化学特論	POLYMER CHEMISTRY	NAGASE YU	2

高分子材料は今や日常生活の中でも、まためざましい進歩を遂げている電気、機械、自動車、宇宙航空などの産業分野や医療分野においても欠かせない材料として重要な役割を果たしています。本講義では、高分子化合物の新しい合成手段や反応などの理解を深めると共に、合成繊維、プラスティック、合成ゴムなどの汎用高分子や膜材料、導電性材料、光機能材料、医用材料などの機能性高分子に関して、高分子化合物の特徴を生かして現在どのような応用展開がなされているかについて解説します。また、将来の高分子材料には何が求められているか、あるいは新しい材料を創製するにはどのような点に配慮すべきかなど、大学院生として高分子材料化学の研究に携わる際の心構えを身に付けられることを目標としています。

本講義は基本的に英語で行い、受講者の英語力を判断してから適宜英語によるディスカッションを体験することに主眼を置いています。前半は、高分子化学における英語の専門用語について解説をして、後半はプレゼンテーションおよび高分子関連の原著論文の読解と説明をゼミ形式で進めます。

Polymer chemistry is an important subject for the development of chemical industries. In particular, the polymer materials are widely used in the fields of electric, mechanic, automobile, space and medical industries.

In this lecture, the basic knowledge for the syntheses, reactions and physical properties of new kinds of polymers will be explained, and the several applications of polymer materials will be commented to understand the characterizations of polymer materials and think what is the desired polymer structure and property in the future.

The lecture will be given mainly in English to develop the skill of hearing, presentation and discussion in English on the bases of polymer chemistry.

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	3	電気回路学特論	ELECTRICAL CIRCUITS	SHOW YOSHIYUKI	2

The electrical circuit is the basic theory in the field of electrical engineering together with electromagnetism. Therefore, deep understandings on the electrical circuit is an important skill for engineering students. This course aims to introduce the fundamental physics of the electrical circuit.

Spring

Common subjects					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	1	TECHNICAL ENGLISH FOR ENGINEERS	TECHNICAL ENGLISH FOR ENGINEERS	BAILEY RICHARD *et al.*	2

The main purpose of this course is to help students develop a strong foundation in English for their future careers. Graduate students in technological fields, whether they will become researchers or work for a company, will need to exchange emails and create documents in English based on the information gathered. They will also need to attend meetings and give presentations in English.

While this course aims to develop their general English abilities in all four skills (reading, writing, speaking and listening), three types of programs will be offered for students to choose from and each type has its special emphasized areas. Type A places an emphasis on oral communication, including presentation and discussion in English. Type B is intended to improve their writing skill including business correspondence, emails, and technical writing. Type C focuses on reading and grammatical rules so that students can comprehend manuals and technical information on the internet or mass media.

Along with these aims, all of the classes will provide TOEIC preparation and they are required to take a TOEIC IP test during the semester, and the result will be calculated in the final evaluation. Students are expected to take a web-based placement in the first session of the program and provide their choices. They will be placed into classes based on their choices and the results on the placement test.

For those who wish to study further, the elective course “English Presentation for Engineers” will be offered in the fall semester. It is designed for students who need more opportunities to practice various skills required to give an effective presentation.

Spring

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	2	物質化学特論	MATERIAL CHEMISTRY	OKAMURA YOSUKE	2

Material Sciences are important subjects for understanding of chemical industries. In this lecture, we understand fabrication processes and evaluation of the various materials synthesized by organic, inorganic and biological approaches. Moreover, we discuss how the basic knowledge work on the behavior of materials. The lecture will be mainly given in English to develop the skills of hearing, presentation and discussion in English based on Material Sciences.

Spring

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	4	電気磁気学基礎論	BASIC ELECTROMAGNETICS	KURODA KAGAYAKI	2

電磁現象のうちヒトの目に見えるものは極めてわずかであり，その大部分は目に見えない波長領域に幅広く存在している．このため，日常においてはその存在にも気づかずに過ごしてしまうことがある．しかし様々の設備・機器に囲まれた現在社会において電磁波などの電磁現象はいますぐそこに，諸君の目の前に，すぐ隣に，あるいは諸君の身体の中にさえ存在している．本講義の目標は，情報社会の根幹を支える，しかし目に触れることの少ない電磁現象の物理学的基礎と，そこで使われる数学的基礎を正確に理解することである．電磁気学は現在の情報関連技術を知るためだけでなく，新たな情報技術・情報科学を創生してゆくためにも必要不可欠な学問である．情報関連技術の単なる使い手としてではなく，その背後にある電磁現象を知りそれらを応用する力を持つ者としての実力を涵養する．
本講義は日英開講である．基本的に教材は英語とし，説明は受講者に応じて両言語で行なう．

Only little portion of electromagnetic phenomena is visible for human, and the majority is lying over a range of invisible wavelength. Thus, we are sometimes not aware of the phenomena at all in our daily life. Electromagnetic phenomena such as electromagnetic waves exist, however, everywhere around us surrounded by enormous amount of electromagnetic devices. They are here, in front of your eyes, next to you, or even inside of your body. The purpose of this lecture is to understand precisely the physical basis of the invisible electromagntic phenomena and the fundamental mathematics to describe them. Electromagnetics is not just for knowing the modern information-related technologies, but also for creating the new science and technology in any field. Therefore, this lecture will foster you not just as a user of the technology, but rater as an creator, who knows how to extend the underlying physical phenomena into engineering fields.

This lecture will be made in both English and Japanese. The materials are basically in English. Oral explanation may be made in both languages according to the attribute of the class members.

Spring

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Sat	2	応用水理学特論・同演習	LECTURES AND EXERCISES ON APPLIED HYDRAULICS	TADA TSUYOSHI	4

水理学は，治水対策・利水対策を考える上で要（かなめ）となる学問です．したがって，土木工学を専攻する学生に是非とも習熟してもらわなければならない重要な科目のひとつです．応用水理学特論では，河川や海岸で生じる非定常の流体現象を偏微分運動方程式等を使って解明する方法を学習します．さらに、これらを人に教えられる力も付けます．このための能力向上法として，アクティブラーニング（ディスカッション，プレゼンテーション等）を採用しております．

Hydraulics is the science necessary to examine flood control and irrigation. Therefore, Advanced Hydraulics is the subject which students who specialize in Civil Engineering should master by all means. In Advanced Hydraulics, you learn some methods for elucidating unsteady phenomena which occur in rivers and seas using partial differential equations. Moreover, let's raise your ability so that you can teach them to other persons. We have adopted Active Learnig (discussion, presentation, etc.) to raise your capability..

Spring & Fall

Common subjects					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Depends on professor		研究ゼミナール	RESEARCH SEMINAR		2

Developments of various electronic materials and devices support continuous progress of advanced technologies. In this seminar, functionalities of metal oxide, such as vanadium dioxide and zinc oxide, are investigated with aims of realizing next generation electronic devices based on oxide semiconductors. As electrical properties are closely related with crystalline structure, fundamentals of crystalline analyses will be lectured. On the understanding of crystalline structure, electrical properties of metal oxide will be expected. Optical properties of material are also essential for understanding electronic band structure of solid-state materials. Relationship between crystalline structure and electronic band structure will be lectured. Students are strongly encouraged to tackle these matters actively in this seminar.

This is an example of the Research Seminar. It is conducted by all the professors in the Graduate School of Engineering. The content varies by professor.

Fall Semester

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	1	電気磁気学特論	ADVANCED ELECTROMAGNETIC	OHYAMA RYUICHIRO	2

電気磁気学において、マクスウェルの方程式は電気磁気現象について数学理論を用いて導出された基礎方程式である。しかし、一般に電気磁気現象は目に見えない場合がほとんどであって、我々は直感的に理解することが難しい。そこで、本講義では、まず比較的容易に理解できるクーロンの法則と電荷の保存則から、電気磁気現象の基礎について直感的な把握を与えることを目標とする。次に、回路素子の基になっている抵抗、静電容量、インダクタンスの概念を深く理解するために、電気回路理論が電気磁気学理論の持つ基本的な性質の集約であることを理解することを目標とする。

以上の目標を達成するために、本講義では電磁現象について各実験事実の間の独立性や相互関連性を認識しながら適宜にレポートと演習を課す。特に、アクティブ・ラーニングの要素として、課題に対するプレゼンテーションを課す。学部で行われている基礎的な科目（電気磁気学、ベクトル解析、微分方程式）を学習しておくと理解しやすい。

In electromagnetic theory, the Maxwell equations are basic equations which describe electromagnetic phenomena. In general, electromagnetic phenomena are invisible so that it is difficult for us to understand them intuitively. In this lecture, intuitive grasp about the basics of electromagnetic phenomena will be given by studies on Coulomb's law and conservation law of the electric charge, which can be understood relatively easily. In addition, for deep understanding on concept of resistance, capacitance, and inductance, which play basic role in electric circuit, this lecture aim for understanding that electric circuit theory are based on the electromagnetic theory. To accomplish above-mentioned aim, some reports and practices are assigned while recognizing independency and interrelationship between experimental facts in electromagnetic phenomena. It is preferred that the students have learned basic subjects such as electric magnetics, vector analysis, and differential equation. Particularly, the students perform the presentation of the problem by the active learning.

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	1	材料強度学特論	STRENGTH OF MATERIALS	WUNDERLICH WILFRIED	2

「強度」は材料の使用に影響を与える指標の一つです。金属では熱処理によってその性質を変化させることが可能です。特に鋼鉄材料では熱処理によって強度を含めたさまざまな特性を調節することができます。材料の強度あるいは破壊靱性を増加させるためには、材料強化のメカニズムを理解することが必要です。

本授業では、前半に、転位とその相互作用を勉強し、弾性・塑性変形を詳しく勉強します。後半では、ジュラルミンに代表される材料の強化法を勉強します。また、疲労、破壊靭性、脆性延性遷移、クリープなど主な機械的性質について勉強します。本授業では金属以外の材料として、セラミックス、ポリマー等も取り扱う予定です。

It was always a dream of mankind to produce high-strength materials, as this physical property is important for many applications. While steel can be strengthened by annealing treatment, duralumin is strengthened by alloying. The goal of this lecture is to understand the physical principle behind the strength.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	3	リモートセンシング特論	REMOTE SENSING	CHO KOHEI	2

リモートセンシングは衛星や航空機等のプラットフォームに搭載されたセンサを用いて地球を観測する技術として現在、気象、海洋、農林、土地利用、環境、雪氷など様々な分野で利用されている。本、講義では、リモートセンシングの応用例などを取り上げながら、リモートセンシングの基本的な原理からリモートセンシングデータの特性、データ処理の流れ、留意事項等についてわかりやすく講義する。

リモートセンシングの原理については、電磁波の性質、物質・電磁波相互作用、黒体放射、放射伝達理論、物体の分光反射特性、大気の透過・散乱・吸収特性等を取り上げる。リモートセンシングデータの特性については、各種プラットフォーム、センサの特性、観測方法、データのフォーマット等に触れながら説明する。そして、衛星から解析までを一連のデータの流れとして捉え、主な留意事項を説明する。また、解析に適するデータにするための補正処理（放射量補正，幾何補正）についても論じる。

Nowadays various kinds of environment problems and disasters are taking place world wide. Remote sensing is one of the most powerful technology to monitor the earth from space using sensors onboard satellites. We see things with our eyes. However, our eyes can only see visible light which is a small portion of the electromagnetic waves. In remote sensing, we use not only visible right but also urtra violet, Infrared, and microwave to monitor the earth environment from space using various sensors. In this lecture, the basic concept of remote sensing is explained using many satellite images.Through thi lecture, you will know what is going on with the earth environment and how we can monitor those phenomenon with remote sensing. Let’s enjoy learning remote sensing.

Used language:
2020 Fall : English
2021 Fall : Japanese
2022 Fall : English
2023 Fall : Japanese

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	3	原子力工学専門講義	TOPICS IN NUCLEAR ENGINEERING	MICHIAKI UTSUMI, ITO ATSUSHI, YASUHISA IKEDA	2

Nuclear engineering is one of big sciences and technologies, whose development definitely requires international collaboration. The importance of the communication of foreign researchers and engineers is rapidly growing. Several topics lectured in English will give you the recognition on not only such a globalization but also a wide field of nuclear engineering. By this course, we will encourage you to learn technical English, especially, in the field of nuclear engineering. We also hope that this course leads you to a good chance to present your study at international conferences in the future.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	3	圧縮性流体の数値解析特論	NUMERICAL ANALYSIS OF COMPRESSIBLE FLUID DYNAMICS	TAKAKURA YOKO	2

春学期の「圧縮性流体力学特論」では，衝撃波・膨張波の発生や温度変化など，非圧縮性流体の流れには見られない特有の現象を伴う圧縮性流体の力学的基礎と諸現象を扱いました．

本科目「圧縮性流体の数値解析特論」では，近年高速の乗り物などの設計に欠かせなくなった圧縮性流体の数値計算を，数学的な基礎に重きを置いて扱います．

まず，一次元スカラー保存則の厳密解の構成方法，リーマン問題の解，数値計算法の収束性の議論などの数学的議論を示すとともに，圧縮性流体の支配方程式の離散化方法として有限体積法を示します．次に現在の数値解法の主流である TVD 法について，基礎を提示するとともに実際の数値計算を示します．さらに TVD 法の欠点を補うべく提案された高精度衝撃波捕獲法について触れます．

以上を通じて圧縮性流体の数値解析の基礎と応用力を養います．

In Lecture on Compressible Fluid Dynamics held in the spring semester, you studied dynamic bases and phenomena of compressible flows, which are accompanied by characteristic phenomena not appearing in incompressible flows, such as generation of shock and expansion waves and change of temperature.

In this subject, Lecture on Numerical Analysis of Compressible Flows, where the mathematical basis is stressed on, you will study the computational fluid dynamics that has recently become indispensable tools for engineering designs.

First, mathematical discussion is presented on construction methods of exact solutions of scalar conservation laws, solutions of the Riemann problems, and convergency of numerical methods, and finite volume methods are shown as the discretization methods for the governing equation of compressible flows. Next, the TVD schemes, mainstream of the recent computational methods, are treated with their basis and practical numerical computations. Further, higher-resolution shock capturing schemes, which were proposed to overcame disadvantages of the TVD schemes, are also presented.

Through the above, you will master the basis and application for numerical analysis of compressible flows.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	3	統計学特論	MATHEMATICAL STATISTICS	TSUCHIYA KAZUYOSHI	2

研究活動に不可欠な以下の内容について解説する.

1）確率

2）回帰分析

3）実験計画法

4）信頼限界

Presentation to show new knowledge for the work after discussion of the experimental results is the last goal of the research in Engineering and science. There are some opportunities for researchers to announce the work in international language “English”, and the researchers need to acquire the presentation ability and the writing ability in English. Therefore, it is indispensable for researchers with an advanced technological level to acquire a statistical technique in English.

In this lecture, the statistics technique to objectively interpret data is explained. Furthermore, the statistics technique is deeply described through the experimental.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Mon	4	機械力学特論	MECHANICAL DYNAMICS	YAMAMOTO YOSHIO	2

The main objective of this class is to nurture knowledge and tools to analyze any mechanical system in a simple and logical manner and to apply a few, well-understood, basic principles to more complicated systems.

First the basic concepts of Newtonian mechanics will be reviewed. Next, basic theories will be presented by applying them to systems of particles and then to idealized bodies such as rods and disks, and finally more general rigid bodies and systems of rigid bodies. On the development of the course, vector analysis will be extensively employed because this approach leads to more concise derivations of the fundamental principles of mechanics and makes it possible to analyze many advanced problems in kinematics and kinetics.

Fall

Common subjects					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	1	ENGLISH PRESENTATION FOR ENGINEERS	ENGLISH RESENTATION FOR ENGINEERS	SHROSBREE Mark *et al.*	2

Students will learn and practice the skills necessary for making a presentation in English. These skills are broken down into two main categories: English skills and general presentation skills. In the English skills category, students will learn the language necessary for organizing a speech, as well as key English expressions for presentations. Students will also work on pronunciation skills and vocal delivery. In the general presentation skills category, students will learn about body language, visual aids, and psychological aspects of speech nerves and dealing with problems.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	2	半導体工学特論	SEMICONDUCTOR PHYSICS	ISOMURA MASAO	2

本講義では、半導体中における電子の振舞いを通して半導体デバイスの諸性質を理解する。まず半導体の結晶構造を説明し、エネルギーバンドの概念を用いて半導体結晶の諸性質を説明する。次に、フェルミディラック統計を用いて半導体中の電子と正孔の分布、不純物の振る舞いを明らかにする。また、真性半導体と不純物半導体 、半導体中を流れる電荷の輸送機構について述べ、重要な関係式や法則を導く。最後に、太陽電池やＭＯＳＦＥＴの動作理論を解説する。

In this lecture, students understand the characteristics of semiconductor devices with regard to the nature of electrons in semiconductor. In the first part, they learn the energy band structure through studying the quantum mechanics and crystalline structure, and understand the fundamental characteristics of semiconductor. Then, they learn the behaviors of carriers such as free electrons and holes due to the Fermi-Dirac distribution, and the substitutional doping of impurity atoms for p and n type semiconductor. In the latter part, the characteristic of carriers in the band structure is understood by the carrier continuity equation and Poisson’s equation. Finally, they learn the operation of semiconductor devices such as MOSFET, solar cells and others.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	2	建築空間計画特論	ARCHITECTURAL SPACE PLANNING	SOGAME AKITO	2

時代を切り開き、建築史に名を刻む建築物には、単に美しさや機能性を追い求めたものだけではなく、確固たる建築思想に基づいた独自の空間計画に対する理念が存在している。ここでは、多様な視点から様々な建築の空間計画について考察し、その建築思想を解き明かしていく。日頃着目することの少ない様々な建築物の空間計画について改めて思考することにより、将来自らが空間計画を行う際に必要となる建築家としての能力の向上を目指し、既成概念に囚われない高い知見を養っていくことを目標とする。

Buildings that create a new era and remain in the history of architecture have not only beauty and functionality, but also a unique space design ideas based on architectural philosophy. In this class, we will be focusing on the parts of space planning from architectures that are not usually noticed. By considering these details, students can improve their ability to plan the space without being bound by conventional concepts.

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	4	エネルギー変換科学特論	ADVANCED ENERGY CONVERSION SCIENCE	YOSHIHITO MATSUMURA	2

Students learn and apply skills in the materials science. Materials science is an interdisciplinary field involving the properties of matter and its applications to various areas of science and engineering. The materials science investigates the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties. In recent years, materials science is focused on nanoscience and nanotechnology has been propelled to the forefront by many researchers.

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Tue	5	セラミックス材料学特論	ADVANCED COURSE ON CERAMIC MATERIALS	MATSUSHITA JUNICHI	2

授業で、各自が調査研究を行ったセラミックス材料学に関する研究開発課題について、マイクロ・ソフト社のプレゼンテーションソフト「パワーポイント®」などを用いて、口頭発表（英語）をし、その後、その発表内容にについて、ディスカッション（英語）を行い、現状の優位点や問題点などを見出しながら、材料に関する研究開発力を研鑽します。口頭発表を通して、高度な発表方法や発表内容などについて修得をはかり、スキルの向上に向けて学習します。本授業では、セラミックス材料学の分野領域の立場、特に工業材料や工業製品の立場を通して、人の生活の豊かさや快適さ、さらに、安全性や環境配慮性などの問題にまで深く掘り下げて、有能な材料研究者・材料技術者としての素養を身につけることができるようにすすめます。

In this class, student will make an oral presentation (in English) on research topics in ceramic materials science. After that, we will discuss the presentation and find out the current advantages and problems, and consider development capabilities for materials.

In this lecture, we will deeply consider the high quality and comfort of life, safety and environmental considerations through the field of ceramic material science, especially industrial materials and products.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	1	バーチャルリアリティ特論	VIRTUAL REALITY	HAMAMOTO KAZUHIKO	2

本講義では，コンピュータで「時空間」情報を扱うための情報処理技術およびそれによって変化する情報処理の概念や世界観について講義する。まず，コンピー他の発展と空間情報処理，バーチャルリアリティの登場，それらの基本概念について述べ，これら空間情報を再生するためのディスプレイ技術，空間情報にアクセスするためのインタフェース技術について論じる。次に，空間情報の表現方法と処理技術に関する「空間情報処理基礎」について講義する。次に，バーチャル空間と実空間の融合技術など異種情報を統合・共有する技術について講義する。また，ネットワークを介して空間情報を転送・共有する技術，テレイグジスタンスについても言及する。最後に，空間情報処理が実現することによるコンピュータの役割の変化，人間の生活における新しいコミュニケーションの形について論じる。

This lecture is given on a technique to process spatiotemporal information in computer and a concept or an outlook on information processing which might be changed by the technique. First, the relationship among the history of computer, virtual reality and spatiotemporal information processing is explained. Next, human interfaces to access spatiotemporal information are explained. After those, the basis of spatiotemporal information processing, which is related to information format, how to get the information and an application to global positioning system. In this section, graph theory is also mentioned. Finally, Mixed Reality, wearable computer and Telexistence are mentioned. These techniques use real space as information space. That means that these techniques might have a power which can change the aspects of communication in human life and the role of computer.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	1	都市開発システム特論	URBAN DEVELOPMENT SYSTEM	KAJITA YOSHITAKA	2

Urban development is one of important factors in urban planning system. Urban developments based on the Urban Development Project System under City Planning Scheme are widely practiced in Japan.
In this lecture, we learn urban development project system such as land readjustment project and urban redevelopment project in Japan by examining various examples. Moreover, Japan supports urban development project in developing countries under the principle of urban growth for inclusive and dynamic development. This lecture also introduces such examples.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	2	電子回路学特論	ANALOG ELECTRONICS	MAGATANI KAZUSHIGE	2

Digital circuits are mainstream in the world of the current electronic equipment. However the backbone of these technology is still the knowledge of analog circuits.　And in many cases Operational amplifier ICs are usually use in the analog circuit as active electronic devices. Operational amplifiers are electronic circuits originally developed for analog computers, however since they are highly functional and rich in versatility, they are used for various electronic circuits.

The objective of this class is to understand the structure of the operational amplifier and to acquire knowledge about application of the operational amplifier. In this class, at first, we will learn the concept of an ideal amplifier and about various electronic circuit methods to realize it. And then we will design a simple operational amplifier circuit by combining learned methods.

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	3	材料加工学応用特論	APPLIED MATERIALS PROCESSING	WUNDERLICH WILFRIED	2

この授業は英語の科目ですので、すべて英語で授業されますが、配布資料は英語と日本語の翻訳、または日本語の説明を含んでいます。授業は比較的優しい英語表現で行いますので、材料学科の専門的内容を英語で学ぶことができます。授業内容としては金属の塑性変形とその応用、つまり高温で成形する方法を注目する。

What skills will you learn? This lecture “Forming process of materials” will be given in English, including handouts for every lecture, Japanese handouts are also available.

It was always a dream of mankind to produce high-strength materials, as this physical property is important for many applications. However, materials are only the base for producing parts, for that we have to study the basics and practical problems of processing and manufacturing. The goal of this lecture is to understand the physical principle of the metal forming by plastic deformation. This lecture is designed for students from material science course, but other students with other background are welcome.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	3	建築パッシブシステム計画特論	ARCHITECTURAL PASSIVE SYSTEM	TAKAHASHI ITARU	2

空調設備システムの設計では、適切な建築外皮の熱的設計が冷暖房エネルギー負荷を大きく低減することに寄与します。また、給排水設備システムでは、太陽給湯でエネルギー使用量、雨水利用で上水使用量、排水浄化処理で水質汚濁負荷、廃棄物処理で廃棄物排出負荷、といった環境負荷が低減可能であり、このような技術の導入が近年ますます一般化してきています。それとともに、むしろ、これらの環境配慮型技術の背景となる成立原理についての理解こそが必要不可欠になっております。　そこで、本講義では、低環境負荷型の建築外皮の熱的デザインと、パッシブシステムの理解に極めて有用なエクセルギー理論について学習します。

Adequate design of building envelopes can contribute to reducing energy use of space cooling and heating to large extent. On the other hand, rain water utilization and waste water purification can contribute to reducing city water use and water purification load. Such architectural passive technologies are essential for realizing environment-conscious building and therefore, we need to learn the fundamental principles that are lying on its background. We will be going to learn the theorem of exergy and architectural passive system.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Wed	5	機械工学特論 B	BASIC MECHANICAL ENGINEERING B	YOSHINAGA MASASHI	2

機械工学は、諸産業の中で最も広い分野を占め、あらゆる産業の基礎をなすものです。したがって、機械工学の持つ内容は、他の工学と比較してきわめて広範囲なものとなっています。特に、最近の学術進歩のめざましい発展に伴い、その事実を修得するだけでも時間を必要とします。一般に専門の授業では、理論学説を中心とした講義が多く、演習時間が少ない傾向にあります。本科目では、基礎となる専門知識、さらに表現力、独創性、理論性、判断力などを備えた総合力を学生自身で身につけることを目標としています。　そのため本科目では、　学部で得た専門基礎知識を復習・整理し、知識を補充し、機械工学専攻の学生にとって必要最低限の知識を身に付けると共に、修士研究の遂行に役立つ情報の提供を目的としています。

機械工学特論 B では材料工学・加工学領域および航空宇宙学領域の専門分野の基礎的事項について理解を確実にし、自己の理解度を評価するために、毎回課題を課し、授業でその課題について説明を行います。よって、学生諸君には、各回とも事前に十分な予習が必要です。また、研究事例を通して応用的な知識も修得する科目です.

Mechanical engineering is widely used for practical engineering and it is addressed as fundamentals of industrial products. That is, the mechanical engineering covers huge areas comparing with other engineering fields. Consequently, we need long time to study it because of the rapid progress of the technologies. However, we have few examinations about the fields though we have many theoretical lectures. In this class, we focus on the fundamentals of the specialty, expression, originality and judgement. These knowledges should be learned by students by themselves in this class. Therefore, the knowledge obtained in bachelor is reviewed and rearranged to utilize it to the master study and thesis. In the class of mechanical engineering B, all the student should make clear about the understanding of the fundamentals of material engineering, cutting work・plastic working, aerospace. For the purpose, we will give homeworks to do in advance of the lecture. All the students have to finish the homework by yourself in advance and submit. By using the homework, we will give some examples of the answer to understand the fundamentals.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	1	ロボット工学特論	ADVANCED ROBOTICS	YAMAMOTO YOSHIO	2

The field of ROBOTICS primarily consists of three sub-fields, namely, kinematics, dynamics and control. This class also deals with these three areas. At the beginning we review some mathematical fundamentals which are essential in studying robotics, especially related to vector and matrix algebra. For kinematics we learn the concept of rigid body motion, homogeneous transformation, Denavit-Hartenberg representation and others. For dynamics part, we learn an introduction of analytical mechanics such as Lagrangian dynamics, constraints, the principle of virtual work and so on, whose understanding is essential for students to learn more advanced issues in robot dynamics and control. For control part, stability issues in robot control will be rigorously treated. It is advised that interested students have fundamental knowledge of linear algebra and calculus. It is also preferable that students already know basics of linear control theory. The outline of the class is listed below. Note that the actual course coverage may vary according to time restriction and other factors.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	1, 2	建築設計スタジオ２	ARCHITECTURAL DESIGN STUDIO 2	KOCHI KAZUYASU	4

大学院で建築設計を学ぶ上において不可欠な考え方とその実践方法を学ぶ授業です。建築設計スタジオ 2 では、建築設計スタジオ 1 で学んだ建築設計プロセスを基として、インターンシップにおいて必要な、より実際的な建築計画・建築設計・プレゼンテーション技術を得ることを目標として課題がだされ、企画・計画・設計・プレゼンテーションといった実務的設計プロセスを学びます。建築家としてどういったプレゼンテーションを行えるかを評価軸として、より実際的なクリティックを受けながら、建築プレゼンテーションのシミュレーションが可能な授業です。

This class is to learn the essential ideas and practical methods for studying architectural design at graduate school. In Architectural Design Studio 2, based on the architectural design process learned in Architectural Design Studio 1, challenges were created with the goal of obtaining more practical architectural planning, architectural design, and presentation skills necessary for internships. Learn practical design processes such as planning, design and presentation. It is a class that allows you to simulate architectural presentations while receiving more practical rituals based on the evaluation axis of what kind of presentation you can give as an architect.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	2	電気電子工学特別演習 2	EEE ADVANCED PRACTICE 2	MIZUTANI KENJI	2

「電気電子工学特別演習 2」は「電気電子工学特別演習 1」とあわせ，工学研究科・電気電子工学専攻において必要となる数学的基礎知識を附与するものである．「電気電子工学特 別演習 1 」においては，微積分，ベクトル解析，函数変換の 3 テーマについて学習する． また「電気電子工学特別演習 2 」では線形代数，複素函数，確率統計について学習する． 両者をあわせて電気電子工学専攻における各種専門科目および修士論文における理論的基礎を涵養することを目的とする．もとより本特別演習が対象とする数学的基礎は学部授業 で基礎的な内容は履修済みである．しかしながらより高度な専門科目への応用，また修士論文における独創的応用を目指すものとすれば，表層的な知識にとどまらず，なぜそのような数学が必要か，また種々の命題の裏に潜む数学的思想を納得しなければならない．また自分の研究に応用するためには，教科書を理解するだけではなく，新たな問題に応用してその知見を駆使できなければならない．この目的を達成するために，本特別演習では講義とともに各種の演習を課す．演習の形態は講義内容に応じて，紙上，板書による命題の導出，証明の演習から，コンピュータ上のシミュレーション演習まで種々工夫される．本演習を効果的に進めるため，本特別演習では履修者を 3 グループに分け，少人数のクラス で講義演習を運用する．第 1 回目の授業でガイダンスおよび応用数学全般にわたる概論を与える．その後各テーマ 4 回の講義演習について各担当教員の指導を受けるものとする． 3 つのテーマを 4 回ずつ計 12 回の講義演習を行う．最後に学力到達度試験を実施し，計 14 回の授業をもって履修完了とする．各講義演習に予習・復習を課す．授業スケジュールに示す各回の講義演習内容について前もって指定される教科書・資料あるいは各自の資料， 図書館資料等を調べ，あらかじめ疑問点等を把握しておくことを課す．復習としては，講義演習で納得できなかった箇所のフォローアップを課す．疑問が残れば，次回の授業で質問することを勧める．

“Electrical and Electronic Engineering Advanced Practice 1 (EEE Advanced Practice 1)” and “Electrical and Electronic Engineering Advanced Practice 2 (EEE Advanced Practice 2)” teach basic mathematics to cultivate theoretical foundations in various specialized subjects and master thesis. In " EEE Advanced Practice 2", students will learn about linear algebra, complex functions, and probability statistics.

This special exercise imposes various exercises along with lectures. Depending on the content of the lecture, various types of exercises will be devised, from derivation of propositions on paper and board. In order to advance this exercise effectively, this special exercise divides students into three groups and do the lecture exercise in a small class.

Guidance will be given in the first class. After that, each instructor will give guidance on the 4 lectures and exercises for each theme. Finally, the achievement test is conducted. The above 14 classes will be completed.

Students are required to check the textbooks / materials specified in advance or their own materials, library materials, etc. for the contents of each lecture / exercise shown in the class schedule, and to grasp any questions in advance. If you have any questions, we recommend that you ask questions in the next class.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	2	航空飛行工学特論	AERONAUTICAL ENGINEERING	MIZUKAKI TOSHIHARU	2

-Purpose

There is no exaggeration to say that the development of aerospace engineering is own to aerodynamics. Due to the nature of compressible fluids, shock waves have been paid a special interest with increasing of the speed of aircraft. Therefore, the research on shock waves has been acting crucial role to make historical events true, such as the manned-supersonic flight and the manned-re-entry from outer space. Generally, shock waves appear around the objects flying at supersonic speeds while an energy release in a minute region generates shock waves too. Then, we do not only need the view of aerodynamics but also that of high-speed dynamics to recognize physics of shock waves. In this course, from the view of high-speed dynamics, we will acquire the characteristics of shock waves, and the involvement with the history of science and technology. Simultaneously, the practical training of technical English will be done.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	3	宇宙システム工学特論	SPACE SYSTEMS ENGINEERING	FUKUDA KOTA	2

In this class, technical features on space system design and integration will be discussed. And some methodologies will be introduced to realize the above design of space system. Another aspect of this class is to improve the communication ability in English for space engineering. For this purpose, several discussions on the aerospace topics will be conducted. A few presentations on the gratitude study and individual topics which interested each student will be requested.

Fall

Course of Mechanical Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Thu	4	材料力学特論	STRENGTH OF MATERIALS	MORIYAMA HIROYUKI	2

For mechanical engineers and researchers, Material Mechanics is in an indispensable study field and its fundamental points should be obtained in the undergraduate education. Not having been treated very well in Material Mechanics, the strain energy is so useful due to convenience of carrying out a computer analysis. In this class, first of all the theorem of Castigliano is referred to as the well-known application of the strain energy. The variation problems, in which the Euler's equation is representative, are studied with respect to the necessary condition to provide a base for the classical variation. However, this procedure takes a roundabout way and a differential equation obtained from the Euler's equation is no more than intermediation, so that we should also consider solving directly this variation problem. In direct methods, the Rayleigh-Ritz method is one of the most significant approximate methods and it is fully supposed to encounter such a variation problem in a master research. Accordingly, this class aims to learn the Rayleigh-Ritz method from concrete examples, e.g. beams, rectangular plates and circular membranes. Moreover, the characteristics of the Rayleigh-Ritz method are clarified from comparisons between the above approximate and exact solutions, so that this class covers the accuracy of the approximation until what makes the approximation more exact.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	2	建築構造材料特別演習	SPECIAL EXERCISE ON STRUCTURAL MATERIALS	WATANABE KEN	2

本講義では、建築構造材料に関する実験によって見出される建築材料の振る舞いの本質を理解すること、将来自主的に研究実験を行う上で必要となる実験計画・測定原理、データ解析の基本を習得することを目標とする。まず、主要建築構造材料である木材、鋼材、コンクリートについて概説する。また、新材料や環境材料についても概説する。次に、それらの材料に関する実験を計画・実施し、結果についての解説を加えることで、建築構造材料への理解を深める。

In this lecture, students will understand the essence of the behavior of building structural materials found through experiments on building structural materials, and the experimental plan / measurement principles and data analysis required for students to conduct research experiments independently in the future. The goal is to master the basics of them. First, we will outline the main building structural materials such as wood, steel, and concrete. Also, new materials and environmental materials will be outlined. Next, students will deepen their understanding of building structural materials by planning and conducting experiments on those materials and adding explanations on the experimental results.

Fall

Course of Electrical and Electronic Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	3	ロボットシミュレーション特論	ROBOTICS SIMULATION	INAGAKI KATSUHIKO	2

Robotics belongs to interdisciplinary field. Thus, to study robotics it is required to study many kinds of fields, such as mechanical engineering, electronic engineering, computer science and so on.
In this class, we use a software library "X Animate" which is developed for robotics engineer. This software can easily build up a robotics animation based on results from any kinds of robotics simulation. To build up a amination sofwtware by use of the library, stident must have some skills, C Programming, UNIX system, basic of robotics kinematics and to read techanical documents written in English.

Fall

Course of Applied Science					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	3	化学熱力学特論	CHEMICAL THERMODYNAMICS	SATO MASASHI	2

Much of what you are willing learn about materials science will rely on your comprehension of thermodynamics. The course gives an introduction to “chemical thermodynamics” in “solids”, with an introductory on materials-related physics and chemistry. Build-up and systematics of materials science are in focuses, with emphasis on characterization of inorganic solids. Several physical / chemical properties are discussed in terms of their importance in modern, advanced materials and application.

In this course, student would give other students the lecture for all topics. We all learn chemical thermodynamics from all students together.

Fall

Common subjects					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	4	工学倫理知財特論	ENGINEERING ETHICS AND INTELLECTUAL PROPERTY	ASOBE MASAKI *et al.*	2

工学研究科では高度の専門性と豊かな人間性を兼ね備え国際的な視野を持った人材の育成を教育の理念としている。本科目はこの理念を具現化させるために、公平な歴史観、世界観に基づいた倫理と社会貢献への熱意を持った人材育成を目的とする。研究者や技術者が持つべき正しい倫理観や国家の枠を超えた社会貢献のあり方について教授すると共に、受講生が自ら考え判断し行動できる力を身に付けることを目指す。また、知的財産権、起業や会社経営、商品化に関わる法規制等の基礎知識を学ぶことで、自らの研究開発の成果を社会貢献につなげることの出来る人材を育成する。

Our philosophy in the graduate school of engineering is to develop competent personnel with high expertise, richness of spirit, and sense of internationality. As one of the ways to realize this philosophy, we are aiming to educate talents, which have enthusiasm to contribute to unbiased view on the history and world. Scientists and engineers should share an education which is aiming for a social contribution in ethics beyond the national frame. The participants of this lecture will approach this aim by doing own effort in judging and acting themselves, in order to develop skills capable of passing on results of their own research and development to the contribution to the society.

Fall

Course of Architecture and Civil Engineering					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Fri	4	海岸水理学特論	COASTAL HYDRAULICS	YAMAMOTO YOSHIMICHI	2

我が国は周囲を海に囲まれた島国であり，建設技術者が港湾・海岸工学について勉学することは極めて有益です．本講義では，沿岸域の開発や保全ならびに海洋開発等を検討する際に不可欠な基礎理論として，流体の基礎式と波動理論について概説します．そして，最新の高潮・津波数値シミュレーション法について解説します．最後に，海岸構造物の最新の設計法である信頼性設計法について解説します．

英語のテキストを使いますので，留学生も履修に困らないでしょう．また，講義の速さは皆さんの理解度に合わせますから，日本人の学生も英語の再勉強をするつもりでトライしてください．

Because Japan is the island country which is surrounded by the Pacific ocean and the Japan sea, it is very useful for many civil engineers to study about Harbor and Coastal Engineering.

1) As the basic theories for the development and the preservation of a coastal zone and an ocean, the physics on sea waves and currents are introduced.

2) The newest numerical simulation method of a tsunami and a storm surge is explained.

3) The latest stability examination method of a coastal structure is explained.

Spring & Fall

Common subjects					
Day	**Period**	**Title (Japanese)**	**Title (English)**	**Professor**	**Credit**
Depends on professor		研究ゼミナール	RESEARCH SEMINAR		2

Developments of various electronic materials and devices support continuous progress of advanced technologies. In this seminar, functionalities of metal oxide, such as vanadium dioxide and zinc oxide, are investigated with aims of realizing next generation electronic devices based on oxide semiconductors. As electrical properties are closely related with crystalline structure, fundamentals of crystalline analyses will be lectured. On the understanding of crystalline structure, electrical properties of metal oxide will be expected. Optical properties of material are also essential for understanding electronic band structure of solid-state materials. Relationship between crystalline structure and electronic band structure will be lectured. Students are strongly encouraged to tackle these matters actively in this seminar.

This is an example of the Research Seminar. It is conducted by all the professors in the Graduate School of Engineering. The content varies by professor.

TOKAI UNIVERSITY

2019

Graduate School of Science

Subjects taught in English

*Class schedule is subject to change

Spring Semester

Course of Chemistry					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
MON	2	自然化学特論	CHEMISTRY OF PHOTOFUNCTIONAL MATERIALS	TOMITA Koji	2

Course Objectives

材料は構造材料と機能材料とに大別できる。本授業では機能材料を中心に、その合成手法、評価方法、および機能発現のメカニズムについて講義する。合成手法では、固相、液相、気相それぞれを経由する様々な手法について触れ、それらの違いとメリットおよびデメリットを理解する。評価手法では、X 線や赤外線などの光を使った分析、熱を用いた分析、電子を利用する分析など、具体的な手法とその原理を理解する。材料の機能について、光の波長を変える材料（蛍光体）、光のエネルギーを利用して酸化還元反応を起こす材料（光触媒）、光のエネルギーによって発電する材料（太陽電池）など、光によって機能する材料を中心に、具体的な物質やその機構について理解する。

なお、本講義は、日本語・英語の両言語で受講することができる。

Materials can be classified into structural materials and functional materials. In this class, synthesis method, evaluation method, and mechanism of functional will be lectured. In the synthesis method, details of solid-state method, solution method, and methods through gas phase are mentioned to understand their differences and advantages and disadvantages. In the evaluation method, you will learn analyses using heat, electron, and light such as X-ray and infrared, and their principle and specific techniques. In the functional materials, you will learn mechanisms and specific materials of phosphors, which convert the wavelength of light, and photocatalysts, which cause redox reaction using energy of light, and solar cells, which generate electric energy by light.

The course is offered both in Japanese and English.

Course of Physics					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
MON	2	素粒子論特論 1	Elementary Particle Theory 1	KITABAYASHI Teruyuki	2

Course Objectives

この講義では素粒子の標準理論の基礎と一歩進んだトピックスを数学的に学びます。まず，素粒子理論の中で最も単純な理論である量子電気力学を可換ゲージ理論の１つとして学びます．量子電気力学は，量子力学と特殊相対性理論，そして電磁気学を融合した理論であり，あらゆる素粒子理論の基礎となる理論です．次に，弱い相互作用の理論が非可換ゲージ理論の１つであることを学びます．非可換ゲージ理論は近代の素粒子理論の根幹をなしています．最後に，電磁相互作用と弱い相互作用を統一的に扱う電弱理論を学びます．この講義を通じて，学生の皆さんはノーベル物理学賞に輝いた幾つかの研究成果も理解することができます．例えば，質量の源に関するヒッグスメカニズムや，クォークの混合に関する小林・益川理論なども学習します．

なお、本講義は、日本語・英語の両言語で受講することができます。

The aim of this course is to present to the students the basic and advanced mathematical concepts of the standard model of particle physics. First, you will be able to understand the simplest theory in the particle physics, the quantum electro dynamics (QED), as an abelian gauge theory. The QED is based on the quantum physics, special theory of relativity and electromagnetism. All theories of the particle physics are based on the QED. Next, the theory of weak interactions is described as a non-abelian gauge theory so that you will be able to understand the key idea of the modern particle physics. Finally, you will learn the electroweak theory as the unified theory of electromagnetic and weak interactions. In this course, you will be introduced some works which are related to the Nobel prize in physics, such as the Higgs mechanism for mass generation and the Kobayashi-Maskawa theory of quark mixings.

The course is offered both in Japanese and English.

Course of Physics					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
MON	4	高分子物理学特論1	POLYMER PHYSICS1	KITA Rio	2

Course Objectives

高分子物理学特論1では、孤立高分子鎖(1 本の高分子鎖)の統計学的な観点における特徴を学ぶことから出発し、溶媒との相互作用が存在する高分子溶液物性を記述するための理論的な事項を学ぶ. さらに現象を記述するための熱力学的な取り扱いの方法を学びつつ、高分子物性計測の原理について理解していく.

(1)高分子 1 本鎖の統計的記述の理解から高分子の特徴を捉える
(2)フローリーーハギンスの格子モデルと溶液物性について
(3)相転移と臨界現象の取り扱い方およびガラス転移やゴム物性などを理解する

上記に加えて、材料として用いられている高分子の機能や特徴を深く理解するために、高分子計測法の原理を併せて学ぶ. また、生体高分子の特長についても学習し高分子と生命現象との関連を探る.

Students will study the knowledge about physical properties of polymers. The description of polymer structure based on a statistical analysis of single polymer chain is the starting point of the polymer physics. Then, molecular interactions between polymer segments and solvents will be studied where the Flory-Huggins theory and the phase diagrams are the key concepts for understanding thermodynamic properties of polymers. Additionally, experimental methods related to those physical properties of polymers will be presented in the course.

(1) To learn the description of polymer structure based on a statistical analysis of single polymer chain
(2) To learn the Flory-Huggins theory for describing solution properties of polymers
(3) To learn the phase transition and critical phenomena, viscoelasticity, glass transition, and so on

To understand the material aspect of polymers, students will learn the principles of experimental methods for characterizing polymers, polymer solutions, and polymer blends. Furthermore, characteristics of bio-polymers will be demonstrated to consider the complicated roles of bio-polymers in vital phenomena.

Course of Physics					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
Tue	3	複雑液体のダイナミックス 1	DYNAMICS IN COMPLEX LIQUIDS 1	SHINYASHIKI Naoki	2

Course Objectives

複雑液体のダイナミックス 1 では液体から固体までの分子性液体，高分子，またこれらの混合系の分子ダイナミックスについて，緩和現象として観測された分子運動を体系的に説明する。

(1)分子の構造や大きさが分子運動に与える影響を理解する。

(2)水や様々な液体，高分子，の液体から非結晶性固体までの分子運動を把握する.

(3)液体からガラス状態までの分子運動について，何がどのように明らかにされたか理解する.

In this course, Dynamics of molecules in complex systems, which are molecular liquids, polymers, and these aqueous solutions from liquid to solid state, will be presented. The dynamics of molecules have been observed as the relaxation processes extending extremely wide time window between pico seconds and mega seconds. The discussions of the relaxation phenomena as the functions of temperature, composition, molecular structure, intermolecular interaction, etc., will be presented systematically.

(1) You will learn the influences of structure and size of molecules to the dynamics of molecules.

(2) You will learn the dynamics of molecules from liquid to solid in non-crystallized substances.

(3) You will learn How the dynamics of molecules have been clarified.

Course of Chemistry					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
WED	1	教育化学特論2	EDUCATIONAL CHEMISTRY 2	ITO Takeru	2

Course Objectives

分子性物質は世の中に数多く存在する。その固体は多くが、静電力・ファンデルワールス力・水素結合などの様々な相互作用によって凝集した結晶である。分子性固体は、設計のしやすさから、新しい機能性物質の制御・構築に欠かせないが、その自在な制御・構築のためには、分子性固体を構成する相互作用とその構造を理解することが必要である。

本講義では、分子性固体を形成する相互作用とその構造、および分子性固体の分析方法について概説する。また、分子性固体で発現する物性についても紹介する。最近の学術論文の紹介を通して、関連論文を読み、手際よくまとめて発表することも行う。

なお、本講義は、日本語・英語の両言語で受講することができます。

Molecular solids are popular materials around the world. A large number of molecular solids are crystalline materials formed by interactions between molecules such as Coulomb, van der Waals, or hydrogen bonding. Molecular structures are often precisely controllable by organic synthetic methods. Therefore, molecular solids are crucial for the design and construction of novel functional materials. To build up novel molecular solids in a precise manner, it is significant to understand the interactions between molecules and to understand the bulk structures derived from each interaction.

This course shows several interactions and structures relevant to molecular solids. The analytical methods and functional properties of molecular solids are concisely shown. Recent articles on molecular solids are discussed if necessary.

The course is offered both in Japanese and English.

Course of Chemistry					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
FRI	2	分析化学特論 2	ANALYTICAL CHEMISTRY 2	MIKAMI Ikko	2

Course Objectives

本講義は、固体表面の物性評価の方法について理解することを目的とします。固体触媒や吸着材、センサー等は、固体表面の機能を利用しており、その性能を評価するには表面の状態を的確に把握することが重要です。固体表面の評価には様々な手法が用いられますが、本講義ではより汎用性の高い評価方法として、赤外線吸収法、X 線光電子分光法、熱分析、表面積・細孔分布測定を取り上げます。各分析法の原理や装置の概要、実際の測定における留意事項について説明します。また、触媒の物性評価を中心とした具体的な適用例を理解することで、データの解釈の仕方を学びます。

なお、本講義は、日本語・英語の両言語で受講することができます。

In this course, you will understand how to evaluate the characteristics of solid surfaces. Solid catalysts, adsorbents, sensors, etc. utilize the function of the solid surface. Therefore, it is important to accurately analyze the surface characteristics in order to evaluate the performance. This course focuses on infrared absorption, X-ray photoelectron spectroscopy, thermal analysis, and surface area / pore distribution measurement as highly versatile evaluation methods. You will understand the principle of each analysis method, the outline of the apparatus, and the tips in actual measurement. In addition, you will learn how to interpret measurement data by understanding specific application examples of physical property evaluation of solid catalysts.

The course is offered both in Japanese and English.

Course of Physics					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
FRI	3	統計力学特論 1	LECTURE ON STATISTICAL MECHANICS1	YAMAGUCHI Makoto	2

Course Objectives

現実に存在するあらゆる量子系は、必ず、その周囲の外界と相互作用することによって不可逆的なエネルギーの交換などを伴います。このようにして外界の影響を継続的に受けている量子系のことを開放量子系と呼びます。　　原理的には、着目している量子系と外界によって構成される全体系に対してシュレディンガー方程式を適用すれば、開放量子系を記述することが可能です。しかしながら、現在のところ、このような方法論は有用性には乏しいと言わざるをえません。

これは例えば、古典力学において空気抵抗を受けながら落下するボールの運動を考えるとき、ボールの運動だけでなく、無数に存在する空気分子の運動についても運動方程式を立てて問題を解こうとすることと似ています。この場合、運動方程式において考慮すべき自由度が多くなりすぎて、具体的な計算や取り扱いが困難となってしまいます。幸いにして古典力学の場合には、ボールの運動だけに着目すると現象論的な取り扱いが可能となり、上記の問題を回避することができます。しかしながら、同様にして量子力学においても現象論的な取り扱いを試みると、演算子の交換関係は時間的に不変であるという量子力学の要請を破ってしまい、理論が破たんしてしまいます。

そこでこの講義では、開放量子系を扱う代表的な枠組みとして量子マスター方程式を学びます。まずはじめに、量子力学における現象論の困難について言及した後、用語の解説や基本方針の説明を行います。次に、量子マスター方程式（Quantum master equation：QME）の導出を行い、熱力学との整合性などを確認します。そして、この方法論を用いると量子力学的な減衰調和振動子や二準位原子の自然放出といった開放量子系の物理を一貫して記述できることを理解します。さらに、超演算子の概念や量子回帰定理についても説明を行い、これらを用いると例えば自然放出のスペクトルなどの計算が可能になることを見ます。

An open quantum system is a quantum sysmtem that interacts with its environmental quantum systems. In general, such interactions cause the dissipation of energy, and as a result, its quantum dynamics cannot be described in terms of a unitary time evolution. Since all quantum systems in reality cannot be free from uncontrolled interactions with their environments, it is important to develop a theory that can treat the dissipative nature in open quantum systems.

This cource provides an introduction to the theory of open quantum systems. Starting from the difficulty in a phenomenological treatment of the quantum dissipation, basic policies and terminologies will be introduced. Then, the quantum master equation (QME) will be explained as a typical framework of open quantum systems. The consistency with thermodynamics will also be discussed. Students will undersand that this general framework can provide a consistent description of open quantum systems, such as a dissipative harmonic oscillator, and spontaneous emission of a two-level atom. Finally, the super-operators and the quantum regression theorem will be introduced, which enable us to discuss, e.g., the spectrum of spontaneous emission.

The course is offered both in Japanese and English.

Course of Mathematics and Mathematical Sciences					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
		代数学通論	Algebra	TAKI Shingo	2

Course Objectives

この授業では多項式の共通零点の集合として理解される古典的な代数幾何について触れる.

代数幾何は様々な数学や物理学の様々な分野と関係しており, 例えばフェルマーの最終定理においては Grothendieck が導入した代数多様体の一般化であるスキームの言葉を存分に用いられて解決を迎えた.（この授業の内容は今後スキーム論を勉強する際の良い助けになると思われる.）

代数幾何学において可換環論は「言葉」なので, この授業を受講する際には基本的な可換環論と位相空間論の知識は必要である.

しかしならが, 必要に応じてこれらの結果は復習していく.

なお、本講義は、日本語・英語の両言語で受講することができます。

This course is intended for students who need to gather a basic understanding of classical algebra geometry, whose aim is to study the geometry underlying the set of common zeros of a collection of polynomial equations.

Algebraic Geometry in its generality is connected to various areas of Mathematics such as Complex Analysis, Complex Manifolds, Number Theory, Dynamical System, Representation Theory, Combinatorics etc and also to areas of Physics like String Theory and Cosmology. The Taylor-Wiles proof of Fermat's Last Theorem used the full machinery and power of the language of Schemes, the most sophisticated language of Algebraic Geometry developed over a couple of decades from the 1960s by Alexander Grothendieck in his voluminous expositions running to several thousand pages. The foundations laid in this class will help in a further study of the language of schemes.

Commutative Algebra is the "language" that Algebraic Geometry uses. Therefore, a prerequisite for this course would be a basic understanding of commutative ring theory and general topology.

However, the necessary results from Commutative Algebra would be recalled as and when required during the course for the benefit of the students.

The course is offered both in Japanese and English.

Fall Semester

Course of Mathematics and Mathematical Sciences					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
Thu	1	解析学特論 D	ANALYSIS D	UEKI Seiichiro	2

Course Objectives

調和関数とはラプラシアンを作用させると 0 になる2回連続微分可能な関数であり、複素関数論の言葉を使うと、ある解析関数の実部となる関数であると言える。調和関数などを詳細に扱う分野は「ポテンシャル論」と呼ばれる解析学の一分野を成している。現在の最先端ではより一般の偏微分方程式を扱い、確率論との関係が研究されているが、その入り口に位置する調和関数の理論には解析学の広範な繋がりを見ることができる。
この講義では、複素関数論の続きとして1次元複素ユークリッド空間内の単位円板上の調和関数の基礎理論について解説する。さらに、調和関数のポワソン積分表示を通して調和関数や有界解析関数の境界挙動を捉える方法を学ぶ。
なお、本講義は日本語・英語の両言語で受講することができます。

A harmonic function is a function which have continuous second order partial derivatives and satisfy Laplace's equation. According to theory of complex analysis, it is also represented by the real part of some analytic function. A harmonic function theory is dealt in ``Potential Theory" which is one of important field in mathematical analysis. In the most advanced research of Potential Theory, researchers investigate into a partial differential equation and probability theory, but theory on harmonic functions as a basic theory in this field have a wide connection with various areas of mathematical analysis.
In this lecture, as a continuation of complex analysis in under graduate course, we will study about a basic theory on harmonic functions on the open unit disk in the complex plane. In the early part of this lecture, we will deal the Poisson integral, Dirichlet problem and the mean value property. By applying the Poisson integral representation theorem, we will also study the boundary behavior of harmonic and bounded analytic functions on the unit disk.
The course is offered both in Japanese and English.

Course of Chemistry					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
THU	2	有機化学特論4	ORGANIC CHEMISTRY	KOGUCHI Shinichi	2

Course Objectives

有機分子を合成するには有機分子の構造、物性の理解が必要であり更に適した合成法の選択が重要である。また得られた化合物を適切な分析法を用いて測定することにより目的物の同定を行う。本講義ではこれら有機合成に必要な一連の作業に必要な基礎知識を得、応用できることを目的とする。また最新の学術論文の紹介を通して、関連論文を読み、発表することも行う。

なお、本講義は日本語または英語で受講することができる。

This lecture aims towards an introduction to the basic organic synthesis chemistry. In order to synthesize the desired organic compound, understand for an appropriate synthetic route and characteristics of compounds is necessary. And synthesized organic compound must be analyzed using appropriate analytical means. The purpose of this lecture is to understand the basic synthetic route of organic compounds. In this lecture, is offered both in Japanese and/or English. However, in case of bad situation, there's a possibility that schedule may be modified.

Course of Mathematics and Mathematical Sciences					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
TBA	TBA	離散数学特論 B	Discrete Mathematics B	MATSUI Yasuko	2

Course Objectives

組合せ最適化は，離散数学の一分野であり，組合せ最適化問題を解くアルゴリズムを研究する分野である．組合せ最適化問題は，様々な組合せ的制約の元で，ある関数が最大(もしくは最小)値をとる解（変数の組合せ）を求める問題である．その解法には，線形計画，組合せ論，多面体等の理論が用いられている．

本講義では，組合せ最適化の結果を古典から最近まで幅広く学ぶ．取り扱うトピックスは，線形計画，整数計画，マッチング理論，ネットワークフローで，理解を深めるために実社会での応用例も紹介する．

なお，本講義は，日本語・英語の両言語で受講できる．

Combinatorial optimization is a field that combines techniques from combinatorics, linear programming, and the theory of algorithms to solve discrete optimization problems. An instance of such a problem typically involves a given finite space of solutions and a rational cost function that assigns a cost to each one of them. The goal is to find a minimum-cost solution efficiently (i.e., in time polynomial in the size of input).

This course serves as a graduate-level introduction to combinatorial optimization. In this course, we will investigate various classical and modern results in combinatorial optimization, including linear programming, integer programming, matchings, and network flows.

The goal is to get a good understanding of some of the most important combinatorial optimization techniques used to solve linear problems and basic combinatorial optimization problems. Motivating examples in various fields of engineering will be presented.

The course is offered both in Japanese and English.

TOKAI UNIVERSITY

2019

Graduate School of Information and Telecommunication Engineering

Subjects taught in English

[Note]

Classes are held on Takanawa Campus

*Class schedule is subject to change

Spring Semester

Spring

＊This class will be held on Takanawa Campus

Course of Information and Telecommunication Engineering					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
MON	3	計算機工学特論	COMPUTER ENGINEERING	SHIMIZU Naohiko	2

電子計算機は、超小型組込みシステムから大規模なクラウドシステムまで、その応用範囲は多岐に渡っている。すべての応用分野に単一の解はなく、応用分野ごと、さまざまな規模および構成の計算機が開発され実用化されている。本科目は、電子計算機の基本的な構成と、現代的な計算機に実装される各種方式について解説し、電子計算機のアーキテクチャとマイクロアーキテクチャの実装方法について、机上だけではなく、電子計算機のハードウェア記述言語による設計コードを用いて議論する。

The computer and related applications are used in many fields of human society. The processing unit sizes can range from very small micro controllers to huge network systems, with their implementation differing depending on the application.

The objective of this course is to introduce the basic organization and the micro architecture of the processing unit of a computer, the method of its design, and the modern micro architecture for performance improvement.

- The basic architecture to process instructions
- Designing the instruction set and decoding method
- Step by step implementation of the instruction set
- Brief introduction of hardware description language
- Discussion on an example processing unit source code.
- Discussion on micro architectures for improved performance

Modern architecture elements: Cache, TLB, Pipeline, Out of Order execution

Spring

＊This class will be held on Takanawa Campus

Course of Information and Telecommunication Engineering					
Day	**Period**	**Course Title (Japanese)**	**Course Title (English)**	**Professor**	**Credit**
TUE	2	ネットワーク情報検索特論	Web Information Retrieval	FUJINO Iwao	2

As a tremendous development of the Internet in recent years, massive information has been transmitted from and spread over anywhere of the world. However just because this, we are experiencing a great confusion when we want to find useful and valuable information from the Internet. In the present era, the way to access information brings us not only conveniences of daily life but also great social reforms. The goal with this course is to introduce the basic technologies for Web information retrieval. By reading an English textbook about Googles PageRank, you will be able to understand the basic ideas and mathematic principle of Web page ranking technology. You will also be able to deal with some practical problems for its large-scale implementation. The main contents of this course are shown as follows:

1. Introduction to Web Search Engines
2. Crawling, Indexing, and Query Processing
3. Ranking Webpages by Popularity
4. The Mathematics of Google’s PageRank
5. Parameters in the PageRank Model
6. The Sensitivity of PageRank
7. The PageRank Problem as a Linear System
8. Issues in Large-Scale Implementation of PageRank

This course is offered in English.