2025 Enrollment

Course List and Summary

Doctoral Degree Program

授業科目表（DC）List of Courses

Department of Mechanical Systems Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること. ただし,学際基盤科目４単位以上修得すること。 A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column, Advanced seminar B,Special lecture B, and Relate subjects. Note that at least 4 credits must be earned from Interdisciplinary basic subjects.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	知的デザイン学特論 Advanced Intelligent Design		E		2		
	エネルギーシステム工学特論 Advanced Energy Systems Engineering		E		2		
	破壊機構学特論 Fracture Mechanics and Mechanisms	毎年 Every year	E		2		
	知能流体システム学特論 Intelligent Fluid Systems		E		2		
	機械システム保全学特論 Advanced Mechanical Systems Maintenance Engineering		E		2		
	多元物質応用システム工学特論 Multidisciplinary Research and Application of Solid-State Ionic Devices	隔年 Every second year	E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
専門科目 Major General Subjects	機械機能創成特別講義B Special Lecture on Mechanical Systems Engineering B				1～4		
	機械機能創成特別研修B Advanced Seminar on Mechanical Systems Engineering B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	機械機能創成博士研修 Doctoral Research Training in Mechanical Systems and Engineering			8			

1,　上記科目の単位数を合わせて 16 単位以上を修得すること（ただし,自専攻の学際基盤科目 4 単位以上修得すること。また,博士研修 8 単位を含む。）

Students must acquire 16 or more credits from the subjects above. (Note that at least 4 credits must be earned from the Interdisciplinary basic subjects of their own department, and 8 credits of Doctoral Research Training)

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Intelligent Design 2 credits
Elective Required
Professor Takahito Ono
Professor Masayoshi Mizutani

Nanotechnology-based nano-precision mechanical manufacturing and micro-nanomachining, and integration technologies of various components are lectured. Precision machines based on above technologies and micro-nanomachines, the design and modeling of those mechanical elements, recent research on applications to information technologies, energy, and medical fields are also lectured.

Advanced Energy Systems Engineering 2 credits
Elective Required
Professor Tetsushi Biwa
Professor Masaya Shigeta
Associate Professor Makoto Shimizu

This course provides students with deep knowledge on the broad topics selected from energy conversion engineering and related fields, such as the control and application methods of heat and fluid energy, as well as renewable energy technology and thermoacoustics. Students will acquire the ability to find out the problems and to pursue the solutions through this lecture.

Fracture Mechanics and Mechanisms 2 credits
Elective Required
Professor Kazuhiro Ogawa
Professor Ken Suzuki

Although a fracture is a well-known phenomenon since early times, the unsolved problem has been left because of the diversity of the influential factors. Therefore, the elucidation of fracture mechanics and mechanisms are desired.
For the elucidation of fracture mechanics and mechanisms, it is necessary that understanding of the interaction and synergistic effect of the diversified influential factors.
In this lecture, fractures of the structures, which are induced by high-temperature oxidation and the environmental assisted cracking, are lectured. Moreover, examples of failure accidents in structures and materials are introduced, its suppression and prevention techniques are discussed.

Intelligent Fluid Systems 2 credits
Elective Required
Professor Kaoru Maruta
Professor Takehiko Sato
Professor Atsuki Komiya

Fundamentals and applications for intelligent control of thermo-fluid flows under the various conditions including microgravity and electro-magnetic field, and its optimized simulation method are discussed. The construction of intelligent fluid systems with sensing, processing, control and actuation and its applications to energy conversion, plasma medicine and material processing are discussed.
Prof. K. Maruta: Fundamental and applications of combustion dynamics
Prof. T. Sato: Plasma medicine and plasma flows
Prof. A. Komiya: Sensing and control of micro-nano scale thermos-fluid flows.

Advanced Mechanical Systems Maintenance Engineering 2 credits
Elective Required
Professor Tetsuya Uchimoto

Maintenance activities play an important role to secure the safety and long-life of various artifacts such as industrial plants, commercial aircrafts. Optimization of the maintenance activities in view of both system safety and economic performance is placed as a major key challenge. In this course, we outline recent progresses of disciplines composing maintenance engineering such as reliability engineering, risk evaluation, nondestructive testing, failure analysis, at first. In addition, we discuss the quantitative evaluation of reliability and risk for optimization of the maintenance activities such as inspection and repair.

Multidisciplinary Research and Application of Solid-State Ionic Devices 2 credits
Elective Required
Professor Koji Amezawa

In this lecture, topics related to basics and applications of ion transport phenomena in solids and on solid surface and/or interface are introduced and discussed from the viewpoints of materials chemistry and solid-state physics. More details, such as the style of the lecture, will be announced in the beginning of the semester.

Advanced Nano/Technology 2 credits
Elective Required
Professor Gao Wei
Professor Koshi Adachi

This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.

Advanced Bio-Nanotechnology 2 credits
Elective Required
Professor Matsuhiko Nishizawa
Professor Tetsu Tanaka
Professor Takafumi Fukushima

Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.

Special Lecture on Mechanical Systems Engineering B 1~4 credits
Elective Required

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Special Seminar on Mechanical Systems Engineering B 1~4 credits
Elective Required
Professor Shuichi Ishida

The problem-posing ability is acquired by integrating advanced expertise through the training.

Doctoral Research Training in Mechanical Systems and Engineering 8 credits
Required

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

授業科目表（DC）List of Courses

Department of Finemechanics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること ただし,学際基盤科目４単位以上修得すること。 A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column, Advanced seminar B,Special lecture B, and Relate subjects. Note that at least 4 credits must be earned from Interdisciplinary basic subjects.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	材料メカニクス特論 Advanced Mechanics of Materials	隔年 Every second year	E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
	ナノ流動学特論 Nano-Flow Science	隔年 Every second year	E		2		
	ソフトメカニクス特論 Advanced Soft Mechanics	隔年 Every second year	E		2		
	破壊機構学特論 Fracture Mechanics and Mechanisms	毎年 Every year	E		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
	医療工学特別講義 Special Lecture on Medical Engineering	毎年 Every year	E		2		
	知的メカノシステム工学特論 Intelligent Mechanosystem Engineering		E		2		
	表面ナノ・マイクロ計測制御学特論 Advanced Nano-and Micro-Surface Metrology and Engineering	隔年 Every second year	E		2		
専門科目 Major General Subjects	ファインメカニクス特別講義Ｂ Special Lecture on Finemechanics B				1～4		
	ファインメカニクス特別研修Ｂ Advanced Seminar on Finemechanics B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	ファインメカニクス博士研修 Doctoral Research Training in Finemechanics			8			

1, 上記科目の単位数を合わせて 16 単位以上を修得すること。(ただし,自専攻の学際基盤科目 4 単位以上修得すること。また,博士研修 8 単位を含む。)
Students must acquire 16 or more credits from the subjects above. (Note that at least 4 credits must be earned from the Interdisciplinary basic subjects of their own department, and 8 credits of Doctoral Research Training.)
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
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3,「使用言語」欄のアルファベット記号について
Language Key
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JE:準英語開講科目 (Lectures basically given in Japanese, with English explanations)
J:日本語開講科目 (Lectures given in Japanese)

History of Modern Technology 2 credits

Elective Required

Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits

Elective Required

Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits

Elective Required

Nano Magnetism and Magnetic Engineering 2 credits

Elective Required

Professor Daichi Chiba

Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Mechanics of Materials 2 credits

Elective Required

Professor Hitoshi Soyama

Professor Hironori Tomyoh

Lecture will deal with methodological explorations about extension of lifetime and enhancement of strength of various materials systems from small systems such as IC packages to large mechanical components and structures, in order to use the systems at severe conditions and/or long time. Microscopic key factors of functional characteristics and performance of the systems are variety of atoms and molecules, their sequences in nanoscale and microstructure in meso-scale. On the basis of these factors, analysis of microscopic characteristics and effects of the microscopic characteristics on macroscopic characteristics will be reviewed including their measurement and evaluation methods, and some real examples will be described in the lecture.

Advanced Nano/Technology 2 credits

Elective Required

Professor Gao Wei

Professor Koshi Adachi

This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.

Nano-Flow Science 2 credits

Elective Required

Professor Takahito Ono

Professor Takashi Tokumasu

Professor Kazuhiko Endo

To realize higher performance and lower energy consumption of advanced green nano-devices such as ULSI, TFT, MEMS/NEMS, sensors, optical devices, solar cells, secondary batteries, thermoelectric conversion devices, and so on, a process technology with atomic-layer-level control of device materials and structure is inevitable. Process technologies (such as etching, thin film deposition, surface modification) are basis of nanotechnology and are realized by utilization and control of plasma, beam, biomolecules, and so on. This

Advanced Soft Mechanics 2 credits

Elective Required

Professor Takeshi Yamaguchi

Associate Professor Toshiaki Nishi

Soft materials such as polymers, rubbers, and gels are called "soft materials." They exhibit mechanical properties and functions different from those of hard materials such as metals and ceramics. In this lecture, mechanical and frictional properties of soft materials, including living body, will be discussed, and the fundamentals and advanced technologies of soft mechanics will be reviewed, including recent research, with applications in sports and medical and welfare fields as subjects.

course will introduce the principle of these nano-processes which is needed for research and development of green nano-devices. Examples of devices fabricated by these processes are also introduced.	
Fracture Mechanics and Mechanisms 2 credits Elective Required Professor Kazuhiro Ogawa Professor Ken Suzuki Although a fracture is a well-known phenomenon since early times, the unsolved problem has been left because of the diversity of the influential factors. Therefore, the elucidation of fracture mechanics and mechanisms are desired. For the elucidation of fracture mechanics and mechanisms, it is necessary that understanding of the interaction and synergistic effect of the diversified influential factors. In this lecture, fractures of the structures, which are induced by high-temperature oxidation and the environmental assisted cracking, are lectured. Moreover, examples of failure accidents in structures and materials are introduced, its suppression and prevention techniques are discussed.	**Advanced Bio-Nanotechnology** 2 credits Elective Required Professor Matsuhiko Nishizawa Professor Tetsu Tanaka Professor Takafumi Fukushima Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.
Special Lecture on Medical Engineering 2 credits Elective Required Professor Yoichi Haga Professor Makoto Ohta Professor Masayoshi Mizutani Professor Kazushi Ishiyama To develop the each student's research leading to innovative medical devices by omnibus lectures given by professors of Division of Medical Device innovation.	**Intelligent Mechanosystem Engineering** 2 credits Elective Required Professor Makoto Ohta Associate Professor Kenichi Funamoto To realize intelligent mechano-systems that autonomously adapt to their environment, it is essential to understand the structure and the mechanisms of sensing and decision-making of intelligent systems in living organisms. This lecture focuses on problems related to the fundamentals and applications of optimization of complex dynamic systems, and aims to develop an intuitive understanding of the most common methods of optimization theory by functional analysis.
Advanced Nano-and Micro-Surface Metrology and Engineering 2 credits Elective Required Professor Wataru Yashiro Measurement and control are the two wheels of manufacturing. The aim of this lecture is to learn the most advanced measurement and control methods covering a wide range of spatial scales from atomic to macroscopic scales of surfaces and interfaces that govern the functions of materials. The ultimate goal of this course is to enable students to gain insight into the current state of measurement and control technology, its limitations, and the potential for opening up new frontiers in materials and life sciences.	**Special Lecture on Finemechanics B** 1~4 credits Elective Required A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Finemechanics B 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.	**Doctoral Research Training in Finemechanics** 8 credits Required Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

授業科目表（DC）List of Courses

Department of Robotics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること． ただし,学際基盤科目４単位以上修得すること。 A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column, Advanced seminar B,Special lecture B, and Relate subjects. Note that at least 4 credits must be earned from Interdisciplinary basic subjects.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
	医療工学特別講義 Special Lecture on Medical Engineering	毎年 Every year	E		2		
	ロボティクス特論 Advanced Robotics	隔年 Every second year	E		2		
	知的メカノシステム工学特論 Intelligent Mechanosystem Engineering		E		2		
	知的デザイン学特論 Advanced Intelligent Design		E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
専門科目 Major General Subjects	ロボティクス特別講義B Special Lecture on Robotics B				1～4		
	ロボティクス特別研修B Advanced Seminar on Robotics B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	ロボティクス博士研修 Doctoral Research Training in Robotics			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（ただし,自専攻の学際基盤科目４単位以上修得すること。また,博士研修８単位を含む。）

Students must acquire 16 or more credits from the subjects above. (Note that at least 4 credits must be earned from the Interdisciplinary basic subjects of their own department, and 8 credits of Doctoral Research Training.)

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JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Bio-Nanotechnology 2 credits
Elective Required
Professor Matsuhiko Nishizawa
Professor Tetsu Tanaka
Professor Takafumi Fukushima

Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.

Special Lecture on Medical Engineering 2 credits
Elective Required
Professor Yoichi Haga
Professor Makoto Ohta
Professor Masayoshi Mizutani
Professor Kazushi Ishiyama

To develop the each student's research leading to innovative medical devices by omnibus lectures given by professors of Division of Medical Device innovation.

Advanced Robotics 2 credits
Elective Required
Professor Satoshi Murata
Professor Shuji Tanaka
Professor Yasuhisa Hirata
Professor Mitsuhiro Hayashibe
Professor Yoshiaki Kanamori
Professor Yoichi Haga
Professor Mami Tanaka
Associate Professor Naoki Inomata
Associate Professor Yusuke Tamura
Associate Professor Shin-ichiro Nomura
Associate Professor Takashiro Tsukamoto
Associate Professor Dai Owaki
Associate Professor Takeshi Okuyama

A robot system can be constructed by organically integrating actuators

Intelligent Mechanosystem Engineering 2 credits
Elective Required
Professor Makoto Ohta
Associate Professor Kenichi Funamoto

To realize intelligent mechano-systems that autonomously adapt to their environment, it is essential to understand the structure and the mechanisms of sensing and decision-making of intelligent systems in living organisms. This lecture focuses on problems related to the fundamentals and applications of optimization of complex dynamic systems, and aims to develop an intuitive understanding of the most common methods of optimization theory by functional analysis.

that realize motion, mechanical elements, microprocessors and sensors that are necessary for realizing intelligent motion. In this lecture, we will focus on cultivating the ability to conceptualize, find problems, and solve problems, which are necessary for the integration of robot systems. Intelligent robots, bio-mechatronics, intelligent mechatronics, micro/nano-mechatronics, etc. will be the subject of concrete research, and lectures and discussions will be held.	
Advanced Intelligent Design 2 credits Elective Required Professor Takahito Ono Professor Masayoshi Mizutani Nanotechnology-based nano-precision mechanical manufacturing and micro-nanomachining, and integration technologies of various components are lectured. Precision machines based on above technologies and micro-nanomachines, the design and modeling of those mechanical elements, recent research on applications to information technologies, energy, and medical fields are also lectured.	**Advanced Nano/Technology** 2 credits Elective Required Professor Gao Wei Professor Koshi Adachi This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.
Special Lecture on Robotics B 1~4 credits Elective Required A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.	**Special Seminar on Robotics B** 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.
Doctoral Research Training in Robotics 8 credits Required Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.	

授業科目表（DC）List of Courses

Department of Aerospace Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること. ただし,学際基盤科目４単位以上修得すること。 A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column, Advanced seminar B,Special lecture B, and Relate subjects. Note that at least 4 credits must be earned from Interdisciplinary basic subjects.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	航空システム特論 Ⅰ Advanced Aero Systems Ⅰ		E		2		
	航空システム特論 Ⅱ Advanced Aero Systems Ⅱ		E		2		
	宇宙システム特論 Ⅰ Advanced Space Systems Ⅰ	毎年 Every year	E		2		
	宇宙システム特論 Ⅱ Advanced Space Systems Ⅱ	毎年 Every year	E		2		
	航空宇宙流体工学特論 Advanced Aerospace Fluid Dynamics		E		2		
専門科目 Major General Subjects	航空宇宙工学特別講義Ｂ Special Lecture on Aerospace Engineering B				1～4		
	航空宇宙工学特別研修Ｂ Advanced Seminar on Aerospace Engineering B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	航空宇宙工学博士研修 Doctoral Research Training in Aeronautics and Space Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（ただし,自専攻の学際基盤科目４単位以上修得すること。また,博士研修８単位を含む。）

Students must acquire 16 or more credits from the subjects above. (Note that at least 4 credits must be earned from the Interdisciplinary basic subjects of their own department, and 8 credits of Doctoral Research Training.)

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Aero Systems I 2 credits
Elective Required
Professor Tomonaga Okabe
Associate Professor Yoshiaki Abe

This course covers computational methods used in aerospace engineering problems and includes the following topics:
1. Introduction to the continuum mechanics for the application of structural analysis and computational fluid dynamics
2. Finite element methods for structural analysis and nonlinear problems.
3. Mathematical foundations of modern computational fluid dynamics and the application to aircraft design processes.
4. Mathematical formulation of multidisciplinary design problems and overview of gradient-based and gradient-free algorithms.
5. Dynamic mode decomposition for modelling of complex and interactive problems.

Advanced Aero Systems II 2 credits
Elective Required
Professor Soshi Kawai
Associate Professor Kai Fukami

This course covers the fundamentals of engineering numerical analysis and advanced fluid mechanics in aerospace engineering and its related fields to study the existing knowledge and remaining issues in the areas of fluid mechanics. The topics will broadly include but not be limited to theories of numerical solutions of ordinary differential equations and discrete transform methods in fluid mechanics, advanced data-oriented fluid dynamics, etc. Students are expected to acquire the fundamental and advanced abilities to perform research and set as doctoral course students through a range of topics in fluid mechanics provided.

Advanced Space Systems I 2 credits
Elective Required
Professor Kazuya Yoshida
Professor Naofumi Ohnishi
Professor Kanjuro Makihara
Professor Toshinori Kuwahara

This course covers advanced issues on space flight systems, which are useful for elaborating PhD level studies of space engineering:
・The scope of the course is the design, development, launch and operation of space flight systems for Earth-orbiting missions and/or interplanetary missions.
・Depending on the availability of the lecturers, a specific focus will be made on the topics from propulsion systems, space structures, orbital mechanics, attitude dynamics and control, and space robotics.
・Lectures can be conducted by invited international lectures.

Advanced Space Systems II 2 credits
Elective Required
Professor Kazuya Yoshida
Professor Naofumi Ohnishi
Professor Kanjuro Makihara
Professor Toshinori Kuwahara

This course provides extensive advanced lectures on space flight systems, particularly the issues not covered by Advanced Space Systems I:
・The scope of the course is the design, development, launch and operation of space flight systems for Earth-orbiting missions and/or interplanetary missions.
・Depending on the availability of the lecturers, a specific focus will be made on the topics from propulsion systems, space structures, orbital mechanics, attitude dynamics and control, and space robotics.
・Lectures can be conducted by invited international lectures.
・All lectures are given in English.

Advanced Aerospace Fluid Dynamics 2 credits
Elective Required
Professor Hiroki Nagai
Professor Hisashi Nakamura

From aerospace engineering and the related fields, this lecture delivers extensive and deep technical knowledge about extreme flows such as the hypersonic flow, propulsion of the spacecraft, flows with various flights, reactive flow. The principal objective of the lecture is the cultivation of the ability of the doctoral course students for problem discovery and the proposition of a new solution method.

Special Lecture on Aerospace Engineering B 1~4 credits
Elective Required

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Special Seminar on Aerospace Engineering B 1~4 credits
Elective Required

The problem-posing ability is acquired by integrating advanced expertise through the training.

Doctoral Research Training in Aeronautics and Space Engineering 8 credits
Required

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

Department of Mechanical Systems Engineering

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical Materials

- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics

- Fluid Dynamics
- Applied Fluid Mechanics

Related to Systems and Design

- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Thermal and Energy

- Thermal Sience and Engineering A
- Thermal Sience and Engineering B

Mathematics and Science

- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics

Others

- Structure and Function of Living System

Related to Mechanical Systems Engineering

Internship / Seminar

- Internship Training
- International Scientific Internship Training

Major General Subjects

- Oxidation in HighTemperature Environments of Structures and Materials
- Design of Natural Energy
- Mechanical Systems Maintenance Engineering

Related to Design and Manufacturing

- Nano/Micro Tribology
- Ultraprecision Machining
- Micro-Nanomechanical Architectonics
- Manufacturing Systems
- Functional Fluids Engineering
- Intelligent Machine Design
- Energy Systems Engineering

Related to Mechanical Systems Engineering

- Introduction to Solid Ionics
- Neuromorphic Device Engineering
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Mechanical Systems Engineering A

Internship / Seminar

- Advanced Seminar on Mechanical Systems Engineering A
- Seminar on Mechanical Systems
- Seminar on Energy Systems Engineering
- Seminar on Intelligent Mechano-Systems
- Master's Research Training in Mechanical Systems and Engineering

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects for Mechanical and Intelligent Systems

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Mechanical Systems Engineering

- Advanced Intelligent Design
- Advanced Energy Systems Engineering
- Fracture Mechanics and Mechanism
- Intelligent Fluid Systems
- Advanced Mechanical Systems Maintenance Engineering
- Multidisciplinary Research and Application of Solid-State Ionic
- Advanced Nano/Technology
- Advanced Bio-Nanotechnology

Major General Subjects

Related to Mechanical Systems Engineering

- Special Lecture on Mechanical Systems Engineering B

Internship / Seminar

- Advanced seminar on Mechanical Systems Engineering B
- Doctoral Research Training in Mechanical Systems and Engineering

Department of Finemechanics

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical Materials

- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics

- Fluid Dynamics
- Applied Fluid Mechanics

Related to Control and Engineering

- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Finemechanics

- Thermal Sience and Engineering A
- Thermal Sience and Engineering B
- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics
- Structure and Function Living System

Major General Subjects

- Sensing and Evaluation of Materials System
- Design of Materials System

Related to Design and Manufacturing

- Nano/Micro Tribolody
- Ultraprecision Machining
- Manufacturing Systems
- Nano/Micro Mechanoptics

Related to Fluid Mechanics

- Biofluid Mechanics

- Optical Metrology
- Green Nanotechnology
- Geo-technical and Energy Engineering
- Biosensor Engineering
- Bio-Micromachine Engineering
- Special Lecture Series on Integrated Biomechanics Ⅰ
- Intelligent Mechanosystem Analysis
- Nano-and Micro-Surface Metrology and Engineering
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Finemechanics A

Internship / Seminar

- Advanced Seminar on Finemechanics A
- Internship Training
- International Scientific Internship Training
- Seminar on Materials and Mechanics
- Seminar on Nanomechanics
- Seminar on Biomechanics
- Seminar on Intelligent Mechano-Systems
- Master's Research Training in Finemechanics

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects for Mechanical and Intelligent Systems

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Finemechanics

- Advanced Mechanics of Materials
- Advanced Nano/Technology
- Nano-Flow Science
- Advanced Soft Mechanics
- Fracture Mechanics and Mechanisms
- Advanced Bio-Nanotechnology
- Special Lecture on Medical Engineering
- Intelligent Mechanosystem Engineering
- Advanced Nano-and Micro-Surface Metrology and Engineering

Major General Subjects

- Special Lecture on Finemechanics B

Internship / Seminar

- Advanced Seminar on Finemechanics B
- Doctoral Research Training in Finemechanics

Department of Robotics

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

Mechanical Systems Course

Finemechanics Course

Robotics Course

Aerospace Engineering Course

Mechanical / Biomedical Engineering Course

International Mechanical and Aerospace Engineering Course

Quantum Science and Energy Engineering Course

Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical

- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics

- Fluid Dynamics
- Applied Fluid Mechanics

Related to Control and Engineering

- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Robotics

Related to Thermal and Energy

- Thermal Sience and Engineering A
- Thermal Sience and Engineering B

Mathematics and Science

- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics

Others

- Structure and Function of Living System

Internship / Seminar

Major General Subjects

Related to Design and Manifacturing

- Micro Electro Mechanical Systems
- Nano/Micro Mechanoptics

Related to Fluid Mechanics

- Functional Fluids Engineering

Related to Control and Engineering

- Advanced Robotics
- Biomechatronics
- Embodied Intelligence and Robotics
- Tough Cyberphysical AI

Related to Robotics

- Foundations of Molecular Robotics
- Intelligent Mechanosystem Analysis
- Neuro Robotics
- Introduction to Solid State Ionics
- Intelligent Control Systems
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Robotics A

Internship / Seminar

- Internship Training
- International Scientific Internship Training
- Advanced Seminar on Robotics A
- Seminar on Nano-Systems
- Seminar on Robot-Systems
- Master's Research Training in Robotics

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects for Mechanical and Intelligent Systems

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Robotics

- Advanced Bio-Nanotechnology
- Special Lecture on Medical Engineering
- Adcanced Robotics
- Intelligent Mechanosystem Engineering
- Advanced Intelligent Design
- Advanced Nano/Technology

Major General Subjects

Related to Robotics

- Special Lecture on Robotics B

Internship / Seminar

- Advanced Seminar on Robotics B
- Doctoral Research Training in Robotics

Department of Aerospace Engineering

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to mechanical

- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics

- Fluid Dynamics
- Applied Fluid Mechanics

Related to Control and Engineering

- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Thermal and Energy

- Thermal Sience and Engineering A
- Thermal Sience and Engineering B

Mathematics and Science

- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics

Other

- Structure and Function of Living System

Major General Subjects

General Subjects

- Environmental Administration
- Ethics of Engineering and Life

- Computational Fluid Dynamics
- Applied Mathematical Fluid Dynamics

- Mathematical Modeling and Computaion
- High Performance Computing
- Computer Architecture

Related to Aerospace

- Aerospace Systems
- Aerospace Propulsion
- Robotics for Space Exploration
- Spacecraft Engineering
- Special Lecture on Aerospace Engineering A

- Physical Fluctuomatics

Internship / Seminar

- Internship Training
- International Scientific Internship Training
- Advanced Seminar on Aerospace Engineering A
- Seminar on Aero Systems
- Seminar on Space Systems
- Master's Research Training in Aeronautics and Space Engineering

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common subjects for Mechanics and Intelligent Systems

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

- Advanced Aero Systems Ⅰ
- Advanced Aero Systems Ⅱ
- Advanced Space Systems Ⅰ
- Advanced Space Systems Ⅱ
- Advanced Aerospace Fluid Dynamics

Major General Subjects

- Special Lecture on Aerospace Engineering B
- Advanced Seminar onAerospace Engineering B
- Doctoral Research Training in Aeronautics and Space Engineering