

<p>Presentation & Discussion 2 credits</p> <p>Elective Required</p> <p>Students learn presentation basics and ways to prepare and deliver presentations in English. Students are asked to give short presentations in English either individually or in groups and to review their own video-taped presentations. In order to familiarize students with discussion modes in English and maximize their use of the target language, English and maximize their use of the target language, English is the primary language for lectures and discussion.</p>	<p>Management of Research and Development 2 credits</p> <p>Elective Required Professor Hideo Miura Professor Yutaka Watanabe</p>
<p>History of Modern Technology 2 credits</p> <p>Elective Required Professor Shiuji Tanaka</p> <p>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 are 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.</p>	<p>Intellectual Property 2 credits</p> <p>Elective Required Professor Hideo Miura Senior Assistant Professor Minoru Watanabe</p>
<p>Venture Management 2 credits</p> <p>Elective Required Professor Akio Nagahira</p>	<p>Venture Strategy 2 credits</p> <p>Elective Required Senior Assistant Professor Toru Degawa Senior Assistant Professor Takumi Kumagai</p>
<p>Advanced Intelligent Design 2 credits</p> <p>Elective Required Professor Tsunemoto Kuriyagawa Professor Takahito Ono Associate Professor Masayoshi Mizutani</p> <p>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 researches on applications to information technologies, energy, and medical fields are also lectured.</p>	<p>Advanced Energy Systems Engineering 2 credits</p> <p>Elective Required Professor Hiroo Yugami Professor Yu Fukunishi Professor Tetsushi Biwa</p> <p>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. Emphasis is placed on improvement of the students' ability to find out the problems and to pursue the solutions.</p>
<p>Fracture Mechanics and Mechanisms 2 credits</p> <p>Elective Required Professor Kazuhiro Ogawa Associate Professor Yoichi Takeda</p> <p>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.</p> <p>For the elucidation of fracture mechanics and mechanisms, it is necessary that understanding of the interaction and synergistic effect of the diversified influential factors.</p> <p>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.</p>	<p>Intelligent Fluid Systems 2 credits</p> <p>Elective Required Professor Kaoru Maruta Professor Takehiko Sato</p> <p>Fundamentals and applications for intelligent control of thermo-fluid flows under the extreme conditions such as high temperature, high pressure, high speed, cryogenic temperature, micro gravity and strong electro-magnetic field, and its optimized simulation method are discussed. Furthermore, the construction of intelligent fluid systems with sensing, processing and actuation and its applications to energy conversion, environmental purification and material processing are discussed.</p> <p>Prof. H. Nishiyama: Functional flow dynamics and its intelligent control Prof. S. Maruyama: Control of micro-nano thermo-fluid transport systems Prof. K. Maruta: Fundamental and applications of combustion dynamics</p>

<p>Advanced Mechanical Systems Maintenance Engineering 2 credits</p> <p>Elective Required Professor Toshiyuki Takagi Professor Tetsuya Uchimoto</p> <p>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.</p>	<p>Multidisciplinary Research and Application of Solid-State Ionic Devices 2 credits</p> <p>Elective Required Professor Koji Amezawa</p> <p>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.</p>
<p>Advanced Damage Tolerance and Design 2 credits</p> <p>Elective Required Professor Hitoshi Soyama Professor Masumi Saka</p> <p>Lecture will deal with various aspects of design concepts and estimations of damage tolerance. Furthermore, to avoid various accidents for aircraft, electric power plant, electric device and nuclear engineering, new concepts on the prediction of fracture life and the estimation of damage accumulation are discussed from the view points of advanced adaptive engineering.</p>	<p>Frontiers of Mechanical Science 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Hitoshi Soyama Professor Masumi Saka Professor Koshi Adachi</p>
<p>Advanced Nano-Technology 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Koshi Adachi</p>	<p>Advanced Bio-Nanotechnology 2 credits</p> <p>Elective Required Professor Matsuhiko Nishizawa Professor Tetsu Tanaka Associate Professor Takafumi Fukushima</p> <p>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.</p>
<p>Advanced Mechanical System and Design 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design coarse</p> <p>This course is prepared for learning various subjects and topics related to the specific field of mechanical systems and design course. The scope covers wide fields related to mechanical system technologies, including intelligent system, engineering design, energy system, and multidisciplinary fields.</p>	<p>IMAC-G Special Seminar on Mechanical Systems and Design 2 credits</p> <p>Elective Required</p> <p>This seminar is prepared for learning various subjects and topics related to the specific field of the course.</p>
<p>Special Lecture on Mechanical Systems and Engineering B</p> <p>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.</p>	<p>Advanced Seminar on Mechanical Systems and Engineering B</p> <p>Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.</p>
<p>Doctor Course Seminar on Mechanical Systems and Engineering 8 credits</p> <p>Elective</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>	

<p>Presentation & Discussion 2 credits</p> <p>Elective Required</p>	<p>Management of Research and Development 2 credits</p> <p>Elective Required Professor Hideo Miura Professor Yutaka Watanabe</p>
<p>Students learn presentation basics and ways to prepare and deliver presentations in English. Students are asked to give short presentations in English either individually or in groups and to review their own video-taped presentations. In order to familiarize students with discussion modes in English and maximize their use of the target language, English is the primary language for lectures and discussion.</p>	<p>The important skills for the effective and rational management of research and development in scientific and technological fields are lectured. Most important issue is how to propose a new R&D project for the human societies near future. Not only the personal skills but also the trend of the science and technology policies all over the world will be discussed. Group discussion for proposing a new R&D project is the most important part of this intensive course for training the management skill of each student. Students are expected to learn the basic important way of thinking for the management of research and development project from the viewpoints of top leader, middle manager, and personal researcher. The most important issue is to be aware of indispensable skills which each student should improve during her/his student life to be a leader of a certain research project near future. This intensive course consists of 3 days. Group discussion often continues to midnight of the second day. Students are expected to attend the three-straight-day course fully.</p>
<p>History of Modern Technology 2 credits</p> <p>Elective Required Professor Shiuji Tanaka</p> <p>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 are 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.</p>	<p>Intellectual Property 2 credits</p> <p>Elective Required Professor Hideo Miura Senior Assistant Professor Minoru Watanabe</p> <p>This course covers the basic idea of law system on intellectual property rights such as patent right, utility model rights, design rights, copyrights, circuit arrangement rights, new plant breeds, and trade secret.</p>
<p>Venture Management 2 credits</p> <p>Elective Required Professor Akio Nagahira</p>	<p>Venture Strategy 2 credits</p> <p>Elective Required Senior Assistant Professor Toru Degawa Senior Assistant Professor Takumi Kumagai</p>
<p>Nano-Photonic Mechanical Systems 2 credits</p> <p>Elective Required Professor Kazuhiro Hane Associate Professor Yoshiaki Kanamori</p> <p>The research field of Mechanical engineering extends to micro/nano scale science and technology. Optical technology is indispensable for investigation and control in micro/nano regions. In this lecture, interactions between photons and atoms/molecules, principles of lasers and their systems, and photonic devices using nano/micro structures are explained and discussed.</p>	<p>Advanced Mechanics of Materials 2 credits</p> <p>Elective Required Professor Hitoshi Soyama Professor Masumi Saka</p> <p>Lecture will deal with methodological explorations about extension of life time 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.</p>

<p>Advanced Nano-Technology 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Koshi Adachi</p>	<p>Mechanical Reliability Design of Advanced Thin-Film Devices 2 credits</p> <p>Elective Required Professor Hideo Miura</p> <p>This course gives students important hints for designing highly functional and highly reliable thin-film devices based on the discussion of the reason for the wide variation of physical and chemical properties of thin-film materials and how to control them. Main topics are as follows. 1) Nano- and Micro-texture-induced variation and fluctuation of physical and chemical properties of materials, 2) Crystallinity-induced changes of electronic and optical performances of thin-film devices, and 3) Degradation of the performances due to the strain-induced anisotropic acceleration of atomic diffusion of component elements in materials.</p>
<p>Nano Flow Dynamics 2 credits</p> <p>Elective Required Professor Seiji Samukawa Associate Professor Takashi Tokumasu</p> <p>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, bio-molecules, and so on. This 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.</p>	<p>Advanced Nano-Physics, Analysis and Control of Surfaces 2 credits</p> <p>Elective Required Professor Yuji Takakuwa</p> <p>This lecture deals with physical phenomena, analyses and controls of solid surfaces and interfaces in a nanometer-scale. Especially, the novel properties of surfaces and interfaces of materials under well controlled conditions, such as under ultra-high-vacuum, are dealt with. In particular, recent topics in the analyses and controls of surfaces and interfaces of silicon and carbon materials will be introduced.</p>
<p>Advanced Damage Tolerance and Design 2 credits</p> <p>Elective Required Professor Hitoshi Soyama Professor Masumi Saka</p> <p>Lecture will deal with various aspects of design concepts and estimations of damage tolerance. Furthermore, to avoid various accidents for aircraft, electric power plant, electric device and nuclear engineering, new concepts on the prediction of fracture life and the estimation of damage accumulation are discussed from the view points of advanced adaptive engineering.</p>	<p>Advanced Intelligence and Systems Engineering 2 credits</p> <p>Elective Required Professor Kazuo Hokkirigawa Associate Professor Takeshi Yamaguchi</p> <p>In order to realize significant increase in performance of mechanical systems such as micro-machine, robots, and space equipment, it is necessary to develop new materials and to establish new design approaches using the materials. This course will provide all students with the fundamental technologies for material development and the advanced knowledge and concept associated with intelligence and systems engineering.</p>
<p>Fracture Mechanics and Mechanisms 2 credits</p> <p>Elective Required Professor Kazuhiro Ogawa Associate Professor Yoichi Takeda</p> <p>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.</p>	<p>Advanced Bio-Nanotechnology 2 credits</p> <p>Elective Required Professor Matsuhiko Nishizawa Professor Tetsu Tanaka Associate Professor Takafumi Fukushima</p> <p>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.</p>

<p>Frontiers of Mechanical Science 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Hitoshi Soyama Professor Masumi Saka Professor Koshi Adachi</p>	<p>Advanced Bio-Mechanics 2 credits</p> <p>Elective Required Professor Yoichi Haga Professor Takuji Ishikawa Associate Professor Makoto Ohta Associate Professor Makoto Kanzaki</p> <p>The Advanced Biomechanics course is based on fundamental knowledge of the anatomy and physiology of mammals, particularly human, discussed in the previous “Structure and Function of the Living System.” Mechanical foundations of the living system, as well as an engineering approach to the biomechanics research of the living system, will be discussed. Content of the lecture includes the solid mechanics of soft and hard tissues; the fluid mechanics of blood and other bodily fluids, as well as the air in the body; and mechanical phenomena in sensory organs such as the ear. In the lecture, cutting edge knowledge of those subjects will be shown, and active participation of students will be expected, to nourish the way of thinking and methodology of biomechanics research.</p>
<p>Intelligent Mechatronics Engineering 2 credits</p> <p>Elective Required Professor Toshiyuki Hayase</p> <p>Intelligent mechano-systems are generally modeled as infinite dimensional nonlinear dynamical systems. As a basis of modern control theory to deal with such systems, we first summarize contents of Intelligent mechano-system Analysis in Masters course focused on the basic concepts of function spaces and optimization theory in Hilbert space, and then study basic concepts to understand more general optimization theories in Banach space such as dual spaces, linear operators, adjoints, from intuitive geometrical point of view.</p>	<p>Advanced Mechanical System and Design 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design course</p> <p>This course is prepared for learning various subjects and topics related to the specific field of mechanical systems and design course. The scope covers wide fields related to mechanical system technologies, including intelligent system, engineering design, energy system, and multidisciplinary fields.</p>
<p>IMAC-G Special Seminar on Mechanical Systems and Design 2 credits</p> <p>Elective Required</p> <p>This seminar is prepared for learning various subjects and topics related to the specific field of the course.</p>	<p>Special Lecture on Finemechanics B</p> <p>Elective Required</p> <p>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.</p>
<p>Advanced Seminar on Finemechanics B</p> <p>Elective Required</p> <p>The problem-posing ability is acquired by integrating advanced expertise through the training.</p>	<p>Doctor Course Seminar on Finemechanics 8 credits</p> <p>Elective</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>

<p>Presentation & Discussion 2 credits</p> <p>Elective Required</p> <p>Students learn presentation basics and ways to prepare and deliver presentations in English. Students are asked to give short presentations in English either individually or in groups and to review their own video-taped presentations. In order to familiarize students with discussion modes in English and maximize their use of the target language, English and maximize their use of the target language, English is the primary language for lectures and discussion.</p>	<p>Management of Research and Development 2 credits</p> <p>Elective Required Professor Hideo Miura Professor Yutaka Watanabe</p>
<p>History of Modern Technology 2 credits</p> <p>Elective Required Professor Shiuji Tanaka</p> <p>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 are 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.</p>	<p>Intellectual Property 2 credits</p> <p>Elective Required Professor Hideo Miura Senior Assistant Professor Minoru Watanabe</p>
<p>Venture Management 2 credits</p> <p>Elective Required Professor Akio Nagahira</p>	<p>Venture Strategy 2 credits</p> <p>Elective Required Senior Assistant Professor Toru Degawa Senior Assistant Professor Takumi Kumagai</p>
<p>Advanced Bio-Nanotechnology 2 credits</p> <p>Elective Required Professor Matsuhiko Nishizawa Professor Tetsu Tanaka Associate Professor Takafumi Fukushima</p> <p>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.</p>	<p>Advanced Bio-Mechanics 2 credits</p> <p>Elective Required Professor Yoichi Haga Professor Takuji Ishikawa Associate Professor Makoto Ohta Associate Professor Makoto Kanzaki</p> <p>The Advanced Biomechanics course is based on fundamental knowledge of the anatomy and physiology of mammals, particularly human, discussed in the previous “Structure and Function of the Living System.” Mechanical foundations of the living system, as well as an engineering approach to the biomechanics research of the living system, will be discussed. Content of the lecture includes the solid mechanics of soft and hard tissues; the fluid mechanics of blood and other bodily fluids, as well as the air in the body; and mechanical phenomena in sensory organs such as the ear. In the lecture, cutting edge knowledge of those subjects will be shown, and active participation of students will be expected, to nourish the way of thinking and methodology of biomechanics research.</p>

<p>Advanced Robotics 2 credits</p> <p>Elective Required Professor Kazuhiro Kosuge Professor Satoshi Murata Professor Shuji Tanaka Professor Yasuhisa Hirata Professor Mitsuhiro Hayashibe Professor Yoichi Haga Professor Mami Tanaka</p>	<p>Intelligent Mechatronics Engineering 2 credits</p> <p>Elective Required Professor Toshiyuki Hayase</p> <p>Intelligent mechatronics are generally modeled as infinite dimensional nonlinear dynamical systems. As a basis of modern control theory to deal with such systems, we first summarize contents of Intelligent mechatronics Analysis in Masters course focused on the basic concepts of function spaces and optimization theory in Hilbert space, and then study basic concepts to understand more general optimization theories in Banach space such as dual spaces, linear operators, adjoints, from intuitive geometrical point of view.</p>
<p>Advanced Intelligent Design 2 credits</p> <p>Elective Required Professor Tsunemoto Kuriyagawa Professor Takahito Ono</p> <p>Nanotechnology-based nano-precision mechanical manufacturing and micro-nanomanufacturing, and integration technologies of various components are lectured. Precision machines based on above technologies and micro-nanomanufacturing, the design and modeling of those mechanical elements, recent researches on applications to information technologies, energy, and medical fields are also lectured.</p>	<p>Frontiers of Mechanical Science 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Hitoshi Soyama Professor Masumi Saka Professor Koshi Adachi</p>
<p>Advanced Nano-Technology 2 credits</p> <p>Elective Required Professor Gao Wei Professor Hiroki Kuwano Professor Koshi Adachi</p>	<p>Advanced Mechanical System and Design 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design course</p> <p>This course is prepared for learning various subjects and topics related to the specific field of mechanical systems and design course. The scope covers wide fields related to mechanical system technologies, including intelligent system, engineering design, energy system, and multidisciplinary fields.</p>
<p>IMAC-G Special Seminar on Mechanical Systems and Design 2 credits</p> <p>Elective Required This seminar is prepared for learning various subjects and topics related to the specific field of the course.</p>	<p>Special Lecture on Robotics B</p> <p>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.</p>
<p>Advanced Seminar on Robotics B</p> <p>Elective Required</p> <p>The problem-posing ability is acquired by integrating advanced expertise through the training.</p>	<p>Doctor Course Seminar on Robotics 8 credits</p> <p>Elective</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>

<p>Presentation & Discussion 2 credits</p> <p>Elective Required</p> <p>Students learn presentation basics and ways to prepare and deliver presentations in English. Students are asked to give short presentations in English either individually or in groups and to review their own video-taped presentations. In order to familiarize students with discussion modes in English and maximize their use of the target language, English and maximize their use of the target language, English is the primary language for lectures and discussion.</p>	<p>Management of Research and Development 2 credits</p> <p>Elective Required Professor Hideo Miura Professor Yutaka Watanabe</p>
<p>History of Modern Technology 2 credits</p> <p>Elective Required Professor Shiuji Tanaka</p> <p>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 are 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.</p>	<p>Intellectual Property 2 credits</p> <p>Elective Required Professor Hideo Miura Senior Assistant Professor Minoru Watanabe</p>
<p>Venture Management 2 credits</p> <p>Elective Required Professor Akio Nagahira</p>	<p>Venture Strategy 2 credits</p> <p>Elective Required Senior Assistant Professor Toru Degawa Senior Assistant Professor Takumi Kumagai</p>
<p>Advanced Aero Systems 2 credits</p> <p>Elective Required Professor Keisuke Asai Professor Tomonaga Okabe Professor Keisuke Sawada</p> <p>This lecture covers experimental simulation methods, numerical simulation methods and analytical methods for fluid dynamics, structural and material sciences, and their coupled applications in aerospace and related engineering fields. Emphasis of this lecture is placed on to cultivate ability of doctoral course students for problem discovery, and for proposition of new solution methods.</p>	<p>Advanced Space Systems 2 credits</p> <p>Elective Required Professor Kazuya Yoshida Associate Professor Toshinori Kuwahara</p> <p>Study advanced engineering issues on space systems.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Advanced knowledge on space environment and spacecraft designs are reviewed, then some advanced topics are elaborated with a special focus on orbital free-flying motion of spacecrafts and robots. <input type="checkbox"/> Advanced issues of orbital mechanics, angular motion kinematics and attitude dynamics of a spacecraft are studied. <input type="checkbox"/> Kalman filter technique is introduced for spacecraft motion determination and other advanced applications. <input type="checkbox"/> Advanced issues of multi-body dynamics and control issues for space robots and manipulators are elaborated. <input type="checkbox"/> Advanced topics including (1) reaction dynamics and control of a free-flying space robot, (2) vibration dynamics and its suppression control of a flexible space robot, (3) impact dynamics and post-impact control when a space robot captures a floating target, (4) teleoperation and telepresence, and (5) mechanical simulation of micro-gravity environment. <input type="checkbox"/> All lectures are given in English.

<p>Advanced Space Fluid Dynamics 2 credits</p> <p>Elective Required Professor Hiroaki Nagai Professor Shigeru Obyashi Professor Hideaki Kobayashi</p> <p>From the aerospace engineering and the related fields, this lecture delivers extensive and deep technical knowledge about the extreme flows such as the hypersonic flow, propulsion of the spacecraft, flows with various flights, supersonic combustion. The principal objective of the lecture is the cultivation of the ability of the doctoral course students for problem discovery and proposition of a new solution method.</p>	<p>Shock Wave in Complex Media and their Interdisciplinary Applications 2credits</p> <p>Elective Required Associate Professor Mingyu Sun</p> <p>Shock wave research was initiated and developed mainly due to tremendous needs from aerospace industry in the past. In recent years, shock wave research is revived especially in complex media encountered in interdisciplinary applications. In this course, their recent applications will be presented. Applications will include shock wave therapy, geophysical applications such as volcanology, underwater shock waves in asteroid impacts on mass extinction, physics of hypervelocity impacts.</p>
<p>Advanced Mechanical System and Design 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design coarse</p> <p>This course is prepared for learning various subjects and topics related to the specific field of mechanical systems and design course. The scope covers wide fields related to mechanical system technologies, including intelligent system, engineering design, energy system, and multidisciplinary fields.</p>	<p>IMAC-G Special Seminar on Mechanical Systems and Design 2 credits</p> <p>Elective Required</p> <p>This seminar is prepared for learning various subjects and topics related to the specific field of the course.</p>
<p>Special Lecture on Aerospace Engineering B</p> <p>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.</p>	<p>Advanced Seminar on Aerospace Engineering B</p> <p>Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.</p>
<p>Doctor Course Seminar on Aerospace Engineering 8 credits</p> <p>Elective Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>	

<p>Presentation & Discussion 2 credits</p> <p>Elective Required</p> <p>Students learn presentation basics and ways to prepare and deliver presentations in English. Students are asked to give short presentations in English either individually or in groups and to review their own video-taped presentations. In order to familiarize students with discussion modes in English and maximize their use of the target language, English is the primary language for lectures and discussion.</p>	<p>Management of Research and Development 2 credits</p> <p>Elective Required</p> <p>Professor Hideo Miura Professor Yutaka Watanabe</p>
<p>History of Modern Technology 2 credits</p> <p>Elective Required</p> <p>Professor Shiuji Tanaka</p> <p>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 are 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.</p>	<p>Intellectual Property 2 credits</p> <p>Elective Required</p> <p>Professor Hideo Miura Senior Assistant Professor Minoru Watanabe</p>
<p>Venture Management 2 credits</p> <p>Elective Required</p> <p>Professor Akio Nagahira</p>	<p>Venture Strategy 2 credits</p> <p>Elective Required</p> <p>Senior Assistant Professor Toru Degawa Senior Assistant Professor Takumi Kumagai</p>
<p>Advanced Quantum Energy Engineering 2 credits</p> <p>Elective Required</p> <p>Professor Makoto Takahashi</p>	<p>Advanced Nuclear Engineering 2 credits</p> <p>Elective Required</p> <p>Associate Professor Keitaro Hitomi</p> <p>In this course, we learn the most advanced particle beam technology such as a high current accelerator to enable the extinction of nuclear waste, the nano-beam technology to enable 3D nano-machining, photon factory to provide high intensity monochromatic X-rays, particle beam therapy, and its application technologies. The fundamentals on nano- and micro-beam formation technology, storage ring, high current particle acceleration, a medical application of accelerator are mainly lectured. Through this lecture, the ability to find, setup, analyze and solve problems is developed.</p>
<p>Advanced Safety Engineering of Nuclear Systems 2 credits</p> <p>Elective Required</p> <p>Professor Yutaka Watanabe Professor Yuichi Niibori Professor Makoto Takahashi Visiting Professor Takayuki Aoki Senior Assistant Professor Masahiro Yamamoto</p>	<p>Advanced Energy Physics Engineering 2 credits</p> <p>Elective Required</p> <p>Professor Hidetoshi Hashizume Professor Tomohiko Iwasaki</p> <p>This class provides advanced technology and its basic knowledge in terms of energy system and neutronics of fusion and fission reactors. Several forefront topics are introduced on the advanced reactor engineering, energy flow dynamics, neutron utilization and fusion plasma confinement to learn how to pick up crucial issues and then how to solve the problems.</p>

<p>Advanced Particle Beam Engineering 2 credits</p> <p>Elective Required Professor Akira Hasegawa</p>	<p>Advanced Energy Material Engineering 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design coarse</p>
<p>Advanced Energy Chemical Engineering 2 credits</p> <p>Elective Required Professor Nobuaki Sato Associate Professor Akira Kirishima</p>	<p>Advanced Quantum Material Engineering 2 credits</p> <p>Elective Required Professor Yasuyoshi Nagai Professor Dai Aoki</p> <p>The state-of-the-art actinide physics and chemistry, radiation damage and the techniques to analyze the material properties, electronic and atomic structures will be reviewed as fundamentals of quantum material engineering.</p>
<p>Advanced Accelerator and Radiation Engineering 2 credits</p> <p>Elective Required To be announced</p>	<p>Medical Molecular Engineering 2 credits</p> <p>Elective Required Professor Hoshi Ohtsu</p> <ol style="list-style-type: none"> 1.Introduction: Overview of technology used in the medical science. 2.Cell and cellular chemistry. 3.The flow of genetic information (The organization and sequences of cellular genomes, replication, maintenance , and rearrangements of genomic DNA,RNA synthesis and processing Protein synthesis , processing and regulation) 4.Cell structure and function. 5.Cell regulation.
<p>Advanced Quantum Science and Energy Engineering 2 credits</p> <p>Elective Required Professors of Quantum Science and Engineering</p> <p>This lecture will deal with the following topics.</p> <ol style="list-style-type: none"> 1. The engineering and physics foundation, and innovative technologies of nuclear energy systems, safety systems, and recycling systems. 2. The engineering and physics foundation of advanced nuclear reactors, such as nuclear fusion and ADS. 3. The science and innovative technology for high loading energy. 4. Applied particle-beam technology. 	<p>Advanced Mechanical System and Design 2 credits</p> <p>Elective Required Professors of Mechanical Systems and Design coarse</p> <p>This course is prepared for learning various subjects and topics related to the specific field of mechanical systems and design course. The scope covers wide fields related to mechanical system technologies, including intelligent system, engineering design, energy system, and multidisciplinary fields.</p>
<p>IMAC-G Special Seminar on Mechanical Systems and Design 2 credits</p> <p>Elective Required</p> <p>This seminar is prepared for learning various subjects and topics related to the specific field of the course.</p>	<p>Special Lecture on Quantum Energy Engineering B</p> <p>Elective Required</p> <p>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.</p>
<p>Advanced Seminar on Quantum Energy Engineering B</p> <p>Elective Required</p> <p>The problem-posing ability is acquired by integrating advanced expertise through the training.</p>	<p>Doctor Course Seminar on Quantum Energy Engineering 8 credits</p> <p>Required</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>