

## 開講授業科目表(DC)

## Opening of a course class subject list

機械機能創成専攻  
Department of Mechanical Systems Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用 言語 Lang uage	単位 Credit			備考 Remarks
				必修 Required	選択必修 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	研究開発マネジメント論 Management of Research and Development	毎年 Every year	JE		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. なお, 特別講義Bと特別研修B及び関連科目で修得した単位は4単位まで本要件に含めることができる.  A student has to earn 8 or more credits from the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	近代技術史学 History of Modern Technology	毎年 Every year	J		2		
	ベンチャー・ビジネス論 Venture Management	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		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	隔年 Every second year	E		2		
Advanced Mechanical Systems Engineering				2			
IMAC-G Special Seminar on Mechanical Systems Engineering				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 Doctor Course Seminar on 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。(自専攻の学際基盤科目から4単位以上履修すること。ただし、特別講義B、特別研修B及び他専攻・他研究科の関連科目の内から4単位以上を選択履修することもできる)

Students must acquire 16 or more credits from the subjects above.(Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department, and can also select 4 or more credits from Special Lecture on Mechanical Systems Engineering B, Advanced Seminar on Mechanical Systems Engineering B and Related subjects of other departments or other schools.)

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。開講年度等は授業時間割等で確認すること。

"Class 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 given in Japanese, with English explanations)

J: 日本語開講科目 (Lectures given in Japanese)

<p><b>Management of Research and Development</b>      2 credits</p> <p>Elective Required  Professor Hideo Miura  Professor Yutaka Watanabe</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&amp;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&amp;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><b>History of Modern Technology</b>      2 credits</p> <p>Elective Required  Professor Shuji 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><b>Venture Management</b>      2 credits</p> <p>Elective Required  Professor Shuichi Ishida</p>	<p><b>Venture Strategy</b>      2 credits</p> <p>Elective Required  Adjunct Instructor Toru Degawa  Adjunct Instructor Takumi Kumagai</p>
<p><b>Nano-Photonic Mechanical Systems</b>      2 credits</p> <p>Elective Required  Professor Kazuhiro Hane  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><b>Advanced Mechanics of Materials</b>      2 credits</p> <p>Elective Required  Professor Hitoshi Soyama  Professor Hironori Tohmyoh</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><b>Advanced Nano/Technology</b>      2 credits</p> <p>Elective Required  Professor Gao Wei  Professor Koshi Adachi</p>	<p><b>Strength and Reliability of Advanced Materials</b>      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><b>Nano-Flow Science</b>      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><b>Advanced Intelligence and Systems Engineering</b>  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><b>Fracture Mechanics and Mechanisms</b>      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><b>Advanced Bio-Nanotechnology</b>      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><b>Special Lecture Series on Integrated Biomechanics II</b>  2 credits</p> <p>Elective Required  Professor Yoichi Haga  Professor Takuji Ishikawa  Professor Makoto Ohta  Associate Professor Makoto Kanzaki</p>	<p><b>Intelligent Mechanosystem Engineering</b>      2 credits</p> <p>Elective Required  Professor Toshiyuki Hayase  Associate Professor Kenichi Funamoto</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><b>Advanced Finemechanics</b>      2 credits</p> <p>Elective Required  Professors of Finemechanics</p> <p>This course is prepared for learning various subjects and topics related to the specific field of Finemechanics.</p>	<p><b>IMAC-G Special Seminar on Finemechanics</b>      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><b>Special Lecture on Finemechanics B</b>      1~4 credits</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><b>Advanced Seminar on Finemechanics B</b>      1~4 credits</p> <p>Elective Required</p> <p>The problem-posing ability is acquired by integrating advanced expertise through the training.</p>

<p><b>Doctor Course Seminar on Finemechanics</b>      8 credits</p> <p>Required</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>	
--	--

開講授業科目表 (DC)

Opening of a course class subject list

ファインメカニクス専攻  
Department of Finemechanics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必修 Required	選択必修 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	研究開発マネジメント論 Management of Research and Development	毎年 Every year	JE		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。なお, 特別講義Bと特別研修B及び関連科目で修得した単位は4単位まで本要件に含めることができる。  A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	近代技術史学 History of Modern Technology	毎年 Every year	J		2		
	ベンチャー・ビジネス論 Venture Management	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノフォトニックメカニカルシステム Nano-Photonic Mechanical Systems	隔年 Every second year	E		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		
	先端材料強度科学特論 Strength and Reliability of Advanced Materials	毎年 Every year	E		2		
	ナノ流動学特論 Nano-Flow Science	隔年 Every second year	E		2		
	知能システム工学特論 Advanced Intelligence and Systems Engineering		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	隔年 Every second year	E		2		
	バイオメカニクス特別講義Ⅱ Special Lecture Series on Integrated Biomechanics II		E		2		
	知的メカニクスシステム工学特論 Intelligent Mechanosystem Engineering		E		2		
	Advanced Finemechanics				2		
IMAC-G Special Seminar on Finemechanics				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						

## 開講授業科目表(DC)

## Opening of a course class subject list

ファインメカニクス専攻  
Department of Finemechanics

区分 Category	授業科目 Subject	開講時期 Schedule	使用 言語 Lang uage	単位 Credit			備考 Remarks
				必修 Required	選択必修 Elective Required	選択 Elective	
専門科目 Major General Subjects	ファインメカニクス博士研修 Doctor Course Seminar on 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。(自専攻の学際基盤科目から4単位以上履修すること。ただし、特別講義B、特別研修B及び他専攻・他研究科の関連科目の内から4単位以上を選択履修することもできる)

Students must acquire 16 or more credits from the subjects above.(Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department, and can also select 4 or more credits from Special Lecture on Finemechanics B, Advanced Seminar on Finemechanics B and Related subjects of other departments or other schools.)

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。開講年度等は授業時間割等で確認すること。

"Class 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 given in Japanese, with English explanations)

J: 日本語開講科目(Lectures given in Japanese)

<p><b>Management of Research and Development</b>      2 credits</p> <p>Elective Required  Professor Hideo Miura  Professor Yutaka Watanabe</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&amp;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&amp;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><b>History of Modern Technology</b>      2 credits</p> <p>Elective Required  Professor Shuji 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><b>Venture Management</b>      2 credits</p> <p>Elective Required  Professor Shuichi Ishida</p>	<p><b>Venture Strategy</b>      2 credits</p> <p>Elective Required  Adjunct Instructor Toru Degawa  Adjunct Instructor Takumi Kumagai</p>
<p><b>Advanced Bio-Nanotechnology</b>      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><b>Special Lecture Series on Integrated Biomechanics II</b>  2 credits</p> <p>Elective Required  Professor Yoichi Haga  Professor Takuji Ishikawa  Professor Makoto Ohta  Associate Professor Makoto Kanzaki</p>
<p><b>Advanced Robotics</b>      2 credits</p> <p>Elective Required  Professor Kazuhiro Kosuge  Professor Satoshi Murata  Professor Shuji Tanaka  Professor Yasuhisa Hirata  Professor Mitsuhiro Hayashibe  Professor Yoshiaki Kanamori  Professor Yoichi Haga  Professor Mami Tanaka</p>	<p><b>Intelligent Mechanosystem Engineering</b>      2 credits</p> <p>Elective Required  Professor Toshiyuki Hayase  Associate Professor Kenichi Funamoto</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><b>Advanced Intelligent Design</b>      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><b>Advanced Nano/Technology</b>      2 credits</p> <p>Elective Required  Professor Gao Wei  Professor Koshi Adachi</p>
<p><b>Advanced Robotics</b>      2 credits</p> <p>Elective Required  Professors of Robotics</p> <p>This course is prepared for learning various subjects and topics related to the specific field of Robotics.</p>	<p><b>IMAC-G Special Seminar on Robotics</b>      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><b>Special Lecture on Robotics B</b>      1~4 credits</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><b>Advanced Seminar on Robotics B</b>      1~4 credits</p> <p>Elective Required</p> <p>The problem-posing ability is acquired by integrating advanced expertise through the training.</p>
<p><b>Doctor Course Seminar on Robotics</b>      8 credits</p> <p>Required</p> <p>Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>	

開講授業科目表(DC)

Opening of a course class subject list

ロボティクス専攻  
Department of Robotics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Lang uage	単位 Credit			備考 Remarks
				必修 Required	選択必修 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	研究開発マネジメント論 Management of Research and Development	毎年 Every year	JE		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。なお、 特別講義Bと特別研修B及び関連科目で修 得した単位は4単位まで本要件に含めること ができる。  A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	近代技術史学 History of Modern Technology	毎年 Every year	J		2		
	ベンチャー・ビジネス論 Venture Management	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology	隔年 Every second year	E		2		
	バイオメカニクス特別講義Ⅱ Special Lecture Series on Integrated Biomechanics Ⅱ		E		2		
	ロボティクス特論 Advanced Robotics	隔年 Every second year	E		2		
	知的メカニクス工学特論 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		
Advanced Robotics				2			
IMAC-G Special Seminar on Robotics				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 Doctor Course Seminar on 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。(自専攻の学際基盤科目から4単位以上履修すること。ただし、特別講義B、特別研修B及び他専攻・他研究科の関連科目の内から4単位以上を選択履修することもできる)

Students must acquire 16 or more credits from the subjects above.(Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department, and can also select 4 or more credits from Special Lecture on Robotics B, Advanced Seminar on Robotics B and Related subjects of other departments or other schools.)

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。開講年度等は授業時間割等で確認すること。

"Class 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 given in Japanese, with English explanations)

J: 日本語開講科目(Lectures given in Japanese)

<p><b>Management of Research and Development</b>      2 credits</p> <p>Elective Required  Professor Hideo Miura  Professor Yutaka Watanabe</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&amp;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&amp;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><b>History of Modern Technology</b>      2 credits</p> <p>Elective Required  Professor Shuji 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><b>Venture Management</b>      2 credits</p> <p>Elective Required  Professor Shuichi Ishida</p>	<p><b>Venture Strategy</b>      2 credits</p> <p>Elective Required  Adjunct Instructor Toru Degawa  Adjunct Instructor Takumi Kumagai</p>
<p><b>Advanced Aero Systems I</b>      2 credits</p> <p>Elective Required  Professor Keisuke Sawada  Professor Keisuke Asai  Professor Tomonaga Okabe  Professor Soshi Kawai</p> <p>This course covers computational methods used in aerospace engineering problems and includes the following topics:</p> <ol style="list-style-type: none"> <li>1. Introduction to the continuum mechanics for the application of structural analysis and computational fluid dynamics</li> <li>2. Finite element methods for structural analysis and nonlinear problems.</li> <li>3. Mathematical foundations of modern computational fluid dynamics and the application to aircraft design processes.</li> <li>4. Mathematical formulation of multidisciplinary design problems and overview of gradient-based and gradient-free algorithms.</li> <li>5. Dynamic mode decomposition for modelling of complex and interactive problems.</li> </ol>	<p><b>Advanced Aero Systems II</b>      2 credits</p> <p>Elective Required  Professor Keisuke Sawada  Professor Keisuke Asai  Professor Tomonaga Okabe  Professor Soshi Kawai</p> <p>This course provides the topics of advanced fluid mechanics researches in aerospace engineering and its related fields, such as aircraft aerodynamic design processes, etc., to study the existing advanced knowledge and remaining issues in the areas of fluid mechanics. The topics will broadly include numerical and experimental researches in fluid mechanics and also how the fluid mechanics researches apply to the aircraft design processes. Students are expected to acquire the ability of problem finding and setting as a doctoral course student through the various topics of fluid mechanics researches provided.</p>

<p><b>Advanced Space Systems I</b>      2 credits</p> <p>Elective Required  Professor Kazuya Yoshida  Professor Naofumi Ohnishi  Professor Kanjuro Makihara  Associate Professor Toshinori Kuwahara</p> <p>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.  •All lectures are given in English.</p>	<p><b>Advanced Space Systems II</b>      2 credits</p> <p>Elective Required  Professor Kazuya Yoshida  Professor Naofumi Ohnishi  Professor Kanjuro Makihara  Associate Professor Toshinori Kuwahara</p> <p>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.</p>
<p><b>Advanced Space Fluid Dynamics</b>      2 credits</p> <p>Elective Required  Professor Hiroki Nagai  Professor Shigeru Obayashi  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><b>Advanced Aerospace Engineering</b>      2 credits</p> <p>Elective Required  Professors of Aerospace Engineering</p> <p>This course is prepared for learning various subjects and topics related to the specific field of Aerospace Engineering.</p>
<p><b>IMAC-G Special Seminar on Aerospace Engineering</b>  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><b>Special Lecture on Aerospace Engineering B</b>  1~4 credits</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><b>Advanced Seminar on Aerospace Engineering B</b>  1~4 credits</p> <p>Elective Required  The problem-posing ability is acquired by integrating advanced expertise through the training.</p>	<p><b>Doctor Course Seminar on Aerospace Engineering</b>  8 credits</p> <p>Required  Students engage in experiments and seminars, including research presentations, discussion and literature reviews.</p>

開講授業科目表(DC)

Opening of a course class subject list

航空宇宙工学専攻  
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			備考 Remarks
				必修 Required	選択必修 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	研究開発マネジメント論 Management of Research and Development	毎年 Every year	JE		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。なお、特別講義Bと特別研修B及び関連科目で修得した単位は4単位まで本要件に含めることができる。  A students has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B , Special lecture B,and Related subjects are included in this requirement.
	近代技術史学 History of Modern Technology	毎年 Every year	J		2		
	ベンチャー・ビジネス論 Venture Management	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		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 Space Fluid Dynamics		E		2		
	Advanced Aerospace Engineering				2		
IMAC-G Special Seminar on Aerospace Engineering				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 Doctor Course Seminar on Aerospace 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。(自専攻の学際基盤科目から4単位以上履修すること。ただし、特別講義B、特別研修B及び他専攻・他研究科の関連科目の内から4単位以上を選択履修することもできる)

Students must acquire 16 or more credits from the subjects above.(Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department, and can also select 4 or more credits from Special Lecture on Aerospace Engineering B, Advanced Seminar on Aerospace Engineering B and Related subjects of other departments or other schools.)

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。開講年度等は授業時間割等で確認すること。

“Class 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 given in Japanese, with English explanations)

J: 日本語開講科目(Lectures given in Japanese)