[Title]			[Instructor]		
Advanced Thermal Engineering			Tetsuaki Takeda / Koji Toriyama / Shumpei Funatani		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM501	2	Mechanical Engineering	1st Semester	Tue.／ III・Ⅳ	Japanese

[Outline and purpose]

The purpose of this lecture is also to understand transport, storage, and conversion of the thermal energy in consideration of a present energy situation. In addition, it is to understand an effective utilization of thermal energy in a practical system.

[Objectives]

Structure and thermal design of the heat transfer apparatus and the heat exchangers can be understood.
The modeling and thermal design of the heat transfer problem can be considered.
Generation, conversion, and utilization of the thermal energy can be understood.
The energy situation not only of Japan, but also oversees countries can be understood and energy problems in the future can be considered.

[Requirements]

Thermodynamics, Hydrodynamics, Thermal engineering, Fluid engineering

[Evaluation]

Report & examination : 100%

[Textbooks]

JSME, JSME Textbook Series Heat Transfer, Maruzen, ISBN:978-4888981200 (in Japanese)

[References]

JSME, JSME Data Book : Heat Transfer 5th Edition, Maruzen, ISBN:978-4-88898-184-2 (in Japanese)

[Schedule]

1 Introduction
2 Foundation of the Heat Transfer
3 Foundation and design of heat exchangers
4 Cooling technology of apparatus / Insulation technology
5 Heat pipe / Peltier element
6 Dimensionless number / dimensional analysis
7 Modeling of the heat transfer problem (temperature and radiation amount estimation)
8 Modeling of the heat transfer problem (heat exchanger, etc.)
9 Energy and environmental situation in Japan and oversees countries
10 Heat transport by thermal conduction, forced convection, natural convection, and thermal radiation
11 Evaluation of thermal efficiency
12 Conversion system of thermal energy
13 Measurement techniques of heat transport phenomenon
14 Flow visualization techniques
15 Heat utilization technologies

[Title]			[Instructor]		
Advanced Mechanical Dynamics and Control			Atsushi Fujimori / Yoshiyuki Noda		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM502	2	Mechanical Engineering	1st Semester	Thu.／I	Japanese

[Outline and purpose]

For safety and efficient motion of machines and robots, it is required to analyze and control the dynamics of mechanical system. The analytical method of mechanical dynamics and the design of control system in consideration of the application to real systems are given in this lecture.

[Objectives]

1. To improve the modeling skill to dynamical properties in mechanical systems.
2. To analysis dynamical systems
3. To understand the concept of robust control
4. To learn robust control design techniques such as H infinity control and μ analysis/design

[Requirements]

``Mechanical Dynamics", ``Vibration Engineering'' and ``Control Engineering'' are needed for taking this class.

[Evaluation]

Homework : 80%
Answer to questions in this lecture : 20%

[Textbooks]

Atsushi Fujimori: *Robust Control*, Corona Publishing, Tokyo, 2001, ISBN: 4-339-03180-1 (in Japanese).

[References]

Shigeru Kurosu, Kouichi Kameoka, Takanori Yamazaki: *Robot Dynamics*, Powersha, Tokyo, 1997, ISBN: 9784827712797 (in Japanese)
N. Macia, George J. Thaler: *Modeling and Control of Dynamic Systems*, Thomson Delmar Learning, New York, USA, 2005
K. Kogoh and T. Mita: *Introduction to System Control Theory*, Jikkyo Publishing, Tokyo, 1979, ISBN: 4-407-02205-1 (in Japanese).

[Schedule]

1. Representation of dynamical systems
2. Rotating system of coordinates
3. Kinematics of rigid body
4. Dynamics of rigid body
5. Euler's equation of motion
6. Dynamics of spinning-top
7. Lagrange Equation of Motion
8. Dynamics of robot arm
9. Introduction to robust control
10. Mathematical preliminaries
11. Uncertainties
12. Robust stability analysis
13. H infinity control
14. Linear matrix inequality
15. Gain-scheduling control

[Title]			[Instructor]		
Advanced Fluid Mechanics			Hiroyuki Tsunoda / Yoshinobu Yamamoto		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM503	2	Mechanical Engineering	1st Semester	Mon.／II	Japanese

[Outline and purpose]

Fluid mechanics tackles the problems of the fluid flow theoretically by assuming the flow as a motion of fluid point. Students are advised to learn the way to handle the flow analytically and theoretically by making full use of the knowledge of fluid mechanics. Starting from the Navier-Stokes equations which are the fundamental equations of fluid motion, first of all, exact solutions of the equations are derived in cases of low and high Reynolds-number limits and then ideas of the boundary layer and the laminar/turbulent flow are described. Furthermore, the fundamental statistical theory, similarity law, and transport properties of turbulence are introduced to understand the turbulence modelling.

[Objectives]

1. to understand the derivation of the Navier-Stokes equations and to explain the physical meaning of each term
2. to understand the idea of the boundary layer and to apply this idea to high Re-number flow around a body
3. to be able to explain the basics of statistical theory, similarity law and transport properties of turbulence
4. to be able to make a decision of the most suitable turbulence model according to the properties of turbulent flows

[Requirements]

Students are expected to have a good understanding on mathematics (especially calculus and vector algebra) and physics (especially dynamics) as well as fundamental fluid engineering.

[Evaluation]

Examination: 45%
Short tests and home works: 25%
Presentation: 25%
Class attitude: 5%

[Textbooks]

[References]

H. Schlichting, K. Gersten, Boundary-Layer Theory, Springer (ISBN:978-3540662709)
F.M. White, Viscous Fluid Flow, McGraw-Hill (ISBN:978-1259002120)
H. Tennekes and J. L. Lumley, A First Course in Turbulence, The MIT Press (ISBN:978-0262200196)
巽 友正, 流体力学 (新物理学シリーズ), 培風館 (ISBN:978-4563024215)
木田重雄, 柳瀬真一郎, 乱流力学, 朝倉書店 (ISBN:4254200951)

[Schedule]

1. Course guidance, vector and tensor notation (Tsunoda)
2. Description of fluid motion and viscous stresses (Tsunoda)
3. Navier-Stokes equations (Tsunoda)
4. Exact solutions of the Navier-Stokes equations (Tsunoda)
5. Similarity law and Re-limiting solutions (Tsunoda)
6. Properties of the boundary layer flow (Tsunoda)
7. Flow instability and laminar-turbulent transition (Tsunoda)
8. The nature of turbulence (Yamamoto)
9. The Reynolds equations (Yamamoto)
10. Statistical theories of turbulence (Yamamoto)
11. The dynamics of turbulence (Yamamoto)
12. Turbulent heat and mass transfer (Yamamoto)
13. Turbulence model; RANS (Yamamoto)
14. Turbulence model; LES (Yamamoto)
15. Review and summary (Tsunoda / Yamamoto)

[Title]			[Instructor]		
Advanced Strength of Materials			Yasumi Ito and Yoshiyuki Kagiyama		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM504	2	Mechanical Engineering	1st Semester	Mon.／Ⅲ	English／Japanese

[Outline and purpose]

Strength of material, which is imperative for manufacturing engineering field, is important tool for ensuring "safety and reassurance" and necessary for development and design of several products. In recent years, strength of materials has been adopted in order to evaluate the material fracture and so on in the area of mechanical engineering, structural dynamics and medical engineering. The aim of this module is to deeply understand the distillate of the manufacturing research by learning the recent studies and developments.

[Objectives]

1. To understand the deformation behavior of materials
2. To consider the contribution of mechanical engineering on the development of the medical devices
3. To understand the dynamics characteristic of biological tissues
4. To understand the health evaluation technique of machines and structures

[Requirements]

Statics and dynamics
Basic strength of materials
Engineering materials

[Evaluation]

Homework: 50%
Presentation work: 50%

[Textbooks]

N. A.

[References]

現代材料力学, 渋谷寿一、本間寛臣、斎藤憲司　共著, 朝倉書店, ISBN:425423051
METAL FORMING ANALYSIS, R. H. Wagoner, Cambridge, 0-521-642671
伊藤安海, 鍵山善之, イラスト医工学　ーバイオメカニクスから医療機器・科学捜査までー, アドスリー, ISBN:978-4-904419-69-4

[Schedule]

1. Introduction
2. Basic concept of finite element method
3. Principles of finite element method / Truss element
4. Principles of finite element method / Truss element
5. Practical knowledge of finite element method
6. Practical knowledge of finite element method
7. Practice of finite element method
8. Practice of finite element method
9. Biomechanics and Strength of materials
10. Bone and soft biological tissue
11. Application to the safety evaluation of biomechanics
12. Non-destructive inspection
13. Failure accident investigating method of machines and structures
14. Discussion of accident examples
15. General overview

[Title]			[Instructor]		
Advanced Material Processing			Yasutake Haramiishi / Yoshiaki Ukita		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM505	2	Mechanical Engineering	2nd Semester	Wed.／I	Japanese

[Outline and purpose]

The suitable structure and strength design are important to produce industrial products having a useful function. In addition, the material processing is also the important process for manufacture of engineering products. The aim of this lecture is to deeply understand the main material processing, such as removal processing, plastic deformation processing, and melt processing.

[Objectives]

1 To understand the characteristic and classification of the processing methods for the manufacturing of engineering products.
2 To understand the mechanism and characteristic of the removal processing.
3 To understand the mechanism and characteristic of the casting and plastic deformation processing.
4 To understand the mechanism and characteristic of the welding processing.

[Requirements]

Fundamental knowledge of material mechanics, plastic deformation and industrial materials of undergraduate level.

[Evaluation]

Periodic examination: 50%
Homework and report: 50%

[Textbooks]

[References]

1 ものづくりの原点素形材技術、素形材センター素形材技術解説書制作委員会編、日刊工業新聞社
2 機械工作法、平井・和田・塚本、コロナ社
3 工業塑性力学、益田森治・室田忠雄、養賢堂
4 弾塑性力学の基礎、吉田総仁、共立出版
5 機械加工学の基礎、奥山繁樹・宇根篤暢・由井明紀・鈴木浩文、コロナ社

[Schedule]

1 Introduction
2 Removal processing 1(Cutting mechanism)
3 Removal processing 2(Cutting tool and surface finishing)
4 Removal processing 3(Grinding mechanism)
5 Removal processing 4(Abrasives and grinding process)
6 Removal processing 5(The latest removal processing)
7 Casting processing 1(Casting mechanism)
8 Casting processing 2(Material of casting)
9 Forging processing
10 Plastic deformation processing 1(Rolling)
11 Plastic deformation processing 2(Press working)
12 Arc welding and gas welding
13 Welding properties and mechanism
14 The latest melt processing
15 General overview and periodic examination

[Title]			[Instructor]		
Advanced Mechanical Materials Engineering			Yoshihiro Nakayama		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM506	2	Mechanical Engineering	2nd Semester	Mon.／I	Japanese

[Outline and purpose]

The aim of this lecture is to deeply understand the material processing, which is required for suitable manufacturing and application of industrial materials. This lecture is carried out with a seminar form. It is required to perform a preliminary investigation for the given theme to the students. In the lecture, students make an oral presentation on the survey results.

[Objectives]

1. To understand the fundamentals of metallic materials
2. To understand the fundamentals of material processing technology for metallic materials
3. To understand the fundamentals of industrial materials
4. To understand the current trends and issues of metallic materials

[Requirements]

Fundamental knowledge of industrial materials of undergraduate level.

[Evaluation]

Periodic examination: 20%
Attendance attitude: 40%
Presentation work: 40%

[Textbooks]

[References]

1 ものづくりの原点素形材技術、素形材センター素形材技術解説書制作委員会編、日刊工業新聞社
2 金属材料の加工と組織、森永正彦・吉原忠・戸田裕之、共立出版

[Schedule]

1. Introduction
2. Mechanical properties of metallic materials
3. Microstructure of metallic materials
4. Evaluation and analysis technics of metallic materials
5. Fundamentals of strengthening of metallic materials
6. Fundamentals of steel and cast iron
7. Fundamentals of stainless steels
8. Fundamentals of aluminum alloys
9. Fundamentals of magnesium alloys
10. Fundamentals of titanium alloys
11. Fundamentals of copper alloys
12. Fundamentals of biomaterials
13. Recycle of metallic materials
14. Novel metallic materials (shape memory alloy, hydrogen storage alloy, porous alloy)
15. General overview and periodic examination

[Title]			[Instructor]		
Advanced Mechanical Systems Engineering			Shigenobu Okazawa / Junichiro Aoyagi		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM507	2	Mechanical Engineering	2nd Semester	Thu.／II	Japanese/ English

[Outline and purpose]

Mechanical systems are integrated systems which is composed by all mechanical engineering techniques such as mechanics, thermodynamics, fluid dynamics, and material dynamics. This lecture learns practical mechanical systems, about space engineering and automotive engineering. Therefore you will understand these basic and comprehensive engineering design concepts in order to design mechanical systems.

[Objectives]

* To understand a components of a spacecraft and its design concept
* To understand a components of a automobile and its design concept
*As the results; to understand comprehensive system engineering design techniques

[Requirements]

Knowledge of basic mechanical engineering such as mechanics, thermodynamics, fluid dynamics and material dynamics, as well as mathematics and English

[Evaluation]

Report and presentation about space engineering 50%
Report about automotive engineering 50%

[Textbooks]

1. Charles D. Brown, Elements of Spacecraft Design, AIAA, ISBN:1563475243

[References]

1. 茂原正道，宇宙システム概論，培風館, ISBN:456303505X (in Japanese)
2. 久田俊明，非線形有限要素法のためのテンソル解析の基礎，丸善，ISBN: 4621045814 (in Japanese)

[Schedule]

1. (Aoyagi) Space environment, and Space mission
2. (Aoyagi) Spacecraft components and its development
3. (Aoyagi) Orbital Mechanics
4. (Aoyagi) Principle of Rocket Propulsion
5. (Aoyagi) Structures
6. (Aoyagi) Thermal Control
7. (Aoyagi) Power System and Attitude Control
8. (Okazawa) Development and manufacturing of automobile
9. (Okazawa) History and environment of automobile
10. (Okazawa) Model-based design of automobile
11. (Okazawa) Technology in performance evaluation of automobile 1
12. (Okazawa) Technology in performance evaluation of automobile 2
13. (Okazawa) Structural analysis of automobile
14. (Okazawa) Impact safety of automobile
15. (Aoyagi and Okazawa) Conclusion

[Title]			[Instructor]		
Seminar in Mechanical Engineering IA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM603	1	Mechanical Engineering	1st Semester		English／Japanese

[Outline and purpose]

Register at the same semester as Research Work in Mechanical System Engineering IA. This is a lecture-style class by the graduate advisor directing your research work. In order to acquire extensive technical knowledge, assignments is not necessarily directly related to the details of your research work.

[Objectives]

To gain the results by an investigation, a design, consideration, the experiment.

[Requirements]

Fundamental knowledge of mechanical engineering of undergraduate level.

[Evaluation]

Comprehensive evaluation from progress of the problem solution, reports and an answer to a question：100%

[Textbooks]

[References]

Depending on the case.

[Schedule]

The lectures by an instructor on the specific assignments.
Student chooses a vice-graduate advisor besides the chief-advisor, and can ask for advice about presentation skills and plan of the research work.

[Title]			[Instructor]		
Seminar in Mechanical Engineering IB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM604	1	Mechanical Engineering	2nd Semester		English／Japanese

[Outline and purpose]

Register at the same semester as Research Work in Mechanical System Engineering IB. This is a lecture-style class by the graduate advisor directing your research work. In order to acquire extensive technical knowledge, assignments is not necessarily directly related to the details of your research work.

[Objectives]

To gain the results by an investigation, a design, consideration, the experiment.

[Requirements]

Fundamental knowledge of mechanical engineering of undergraduate level.

[Evaluation]

Comprehensive evaluation from progress of the problem solution, reports and an answer to a question：100%

[Textbooks]

[References]

Depending on the case.

[Schedule]

The lectures by an instructor on the specific assignments.
Student chooses a vice-graduate advisor besides the chief-advisor, and can ask for advice about extensive technical knowledge around the research work.

[Title]			[Instructor]		
Research Work in Mechanical Engineering IA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM607	2	Mechanical Engineering	1st Semester		English／Japanese

[Outline and purpose]

The purpose of this research work is to gain fundamental knowledge and technology of selected subject of research under the tuition of supervisor. Comprehension of background and purpose of research, planning of research schedule and accomplishment of research with initiative are required. Comprehension of research subject is promoted with report and discussion.

[Objectives]

Comprehension of social demand about engineering and technology and findings of subject and ability of problem solving is acquired. Ability of accomplishing study and research with initiative is acquired. Ability of presentation and communication on the presentation and discussion of research work is cultivated.

[Requirements]

Fundamental knowledge of mechanical engineering of undergraduate level.

[Evaluation]

Others (Evaluate the appropriateness of answer to questions): 100%

[Textbooks]

[References]

Instruct if required

[Schedule]

Accomplish the selected subject of research under the tuition of supervisor.

[Title]			[Instructor]		
Research Work in Mechanical Engineering IB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTM608	2	Mechanical Engineering	2nd Semester		English／Japanese

[Outline and purpose]

The purpose of this research work is to gain fundamental knowledge and technology of selected subject of research under the tuition of supervisor. Comprehension of background and purpose of research, planning of research schedule and accomplishment of research with initiative are required. Comprehension of research subject is promoted with report and discussion.

[Objectives]

Comprehension of social demand about engineering and technology and findings of subject and ability of problem solving is acquired. Ability of accomplishing study and research with initiative is acquired. Ability of presentation and communication on the presentation and discussion of research work is cultivated.

[Requirements]

Fundamental knowledge of mechanical engineering of undergraduate level.

[Evaluation]

Others (Evaluate the appropriateness of answer to questions): 100%

[Textbooks]

[References]

Instruct if required

[Schedule]

Accomplish the selected subject of research under the tuition of supervisor.