Space Engineering International Course
Syllabus 2019

＊These are lecture-based subjects which you will see on SEIC timetable. As for subjects such as PBL, Internship, Thesis Research for Degree, and Project Research, etc., please consult with your supervisor for details.

Advanced Architectural Structure（建築構造特論）

Lecturer, Credit
CHEN Pei-Shan, Credit 2

1. Course Description
This course will introduce you to the study of nonlinear behavior of structures, including the basic theories on buckling analysis of space frames, analysis of cable structures, and Elasto-Plastic analysis of rigid frames. Furthermore, this course will equip you with the knowledge to anchor your understanding of structural design of space structures, high-rise buildings and mechanical structures. This is also a course of Space Engineering, and the lectures will be given in English.

2. Schedule
(1) Introduction, Nonlinear analysis (Part 1): Nonlinear Analysis of a 2-Bar system
(2) Nonlinear analysis (Part 2): Principle of stationary potential energy
(3) Nonlinear analysis (Part 3): Iteration and incremental analysis (Geometric stiffness)
(4) Nonlinear analysis (Part 4): Coordinate transformation and nonlinear element stiffness matrices
(5) Nonlinear analysis (Part 5): Nonlinear stiffness matrices by principle of virtual work
(6) Nonlinear analysis (Part 6): Incremental analysis and convergence
(7) Nonlinear analysis (Part 7): Nonlinear buckling analysis and bifurcation of space frames
(8) Nonlinear analysis (Part 8): Linear buckling
(9) Cable structure (Part 1): Introduction; Suspension cables (parabolic profile)
(10) Cable structure (Part 2): Suspension cables (catenary profile), Influence of boundary condition
(11) Cable structure (Part 3): Prestressing analysis of tensegric structures
(12) Cable structure (Part 4): Linear and nonlinear analysis of tensegric Structures
(13) Elasto-plastic analysis (Part 1): Introduction, Homogeneous Beams
(14) Elasto-plastic analysis (Part 2): Combined Bending and axial force
(15) Elasto-plastic analysis (Part 3): Elasto-plastic analysis of structures

3. Purpose
1. Knowledge of nonlinear analysis of space frames and mechanical structures.
2. Knowledge of analysis of cable structures.
3. Elasto-plastic analysis of building and mechanical structures.

4. Method of evaluation
The overall grade will be decided based on short reports and the attendance.

5. Notification
It is desirable that the attendees have the basic knowledge of Structural Mechanics.

6. Additional work
Attendees of this course should review the concerning lessons provided in undergraduate curricula. Furthermore, the attendees should prepare to explain and/or solve questions in turn during lectures. Reports should be submitted in time.

7. Text book and Reference book
No textbook. Reference books may be introduced during the lecture.

8. Key words

9. Email address
chen@civil.kyutech.ac.jp

Advanced Course of Aerospace Guidance and Control
(航空宇宙の誘導制御学特論)

Lecturer, Credit

YONEMOTO Koichi, Credit 2

1. Course Description

The objective of this lecture (conducted in English) is to gain the knowledge of the basic theory of flight dynamics, guidance and control, and their application to aircraft and spacecraft.

2. Schedule

You will learn the basic theory of flight dynamics, guidance and control of aircraft in the first half of lecture, and those of spacecraft in the latter half.

I. Aircraft
- (1) Introduction to Aircrafft
- (2) Aircraft Systems
- (3) Fight Control Systems
- (4) Equations of Motion and Linearization
- (5) Stability and Trim Performance
- (6) Aircraft Dynamic and Control
- (7) Stability Augmentation

II. Spacecraft
- (1) Introduction to Attitude Control of Spacecraft
- (2) Definition of Attitude and Equations of Motions
- (3) Feedback Control with On-Off Thrusters
- (4) Attitude Control with Reaction Wheels
- (5) Attitude Stabilization with Spin
- (6) Gravity Gradient Torque and Attitude Stabilization
- (7) Geomagnetic Field, Solar Radiation Pressure and Aerodynamic Torque
- (8) Spacecraft Sensor and Attitude Determination
- (9) Translational Motions in Circular Orbit

Ⅲ. Rocket
- (1) Introduction to Rocket
- (2) Navigation Guidance and Control

3. Purpose

4. Method of evaluation

Grade is evaluated by taking the score of final exam or submission of reports into account.

5. Notification

It is desirable or recommended for the students to take courses related to “Fluid Dynamics (Aerodynamics)”, “Dynamics of Machinary” and "Control Engineering" in the undergraduate course.

6. Additional work

Learn the class topics by reading the references in advance, and review the distributed prints to resolve all the questions.

7. Text book and Reference book

[1] Bakelock, Jphn, H., “Automatic Control of Aircraft and Missiles,” John Wiley and Sons Inc. (1965).
[2] McRouer, Duane, et.al, “Aircraft Dynamics and Automatic Control,” Princeton University Press

(1973).
[3] McLean Dnald, “Automatic Flight Control Systems,” Prentice Hall International Ltd. (1990 年).
[4] 加藤寛一朗他:航空機力学入門, 東京大学出版会 (1982).
[5] Vladimir A. Chobotov: Spacecraft Attitude Dynamics and Control, Krieger Publishing Company (1991).
[6] Marcel J. Sidi: Spacecraft Dynamics and Control, Cambridge University Press (1997),
[7] Peter C. Hughes: Spacecraft Attitude Dynamics, Dover Publications, Inc. (2004).
[8] Anton H.J. De Ruiter, et al., “Spacecraft Dynamics and Control” John Wilky & Sons (2013).
[9] 茂原正道:宇宙工学入門, 培風館 (1995 年).

8. Key words

9. Email address

Advanced High Velocity Impact Engineering（高速衝突工学特論）

Lecturer, Credit
AKAHOSHI Yasuhiro, Credit 2

1. Course Description
The objective of this lecture is to gain the knowledge of the basic theory of high velocity impact such as fan blade off damage on fan case or hypervelocity impact on space structure such as space debris impact on International Space Station. In this lecture stress propagation and mechanism of hypervelocity impact phenomena will be addressed. The course's aim is also to further one's understanding in a specialised field through English.

2. Schedule
(1) Introduction of space debris 宇宙ごみの概要
(2) Introduction of low, high, hypervelocity impact 低速、高速、超高速衝突の概要
(3) Fundamental relationships(1) 基礎式（その1）
(4) Fundamental relationships(2) 基礎式（その2）
(5) Material response(1:metals and ceramics) 材料応答（その1）
(6) Material response(2:composites) 材料応答（その2）
(7) Impedance インピーダンス
(8) Non-penetrating impacts 非貫通衝突
(9) Strength Effect 材料強度依存
(10) Tate model テイトモデル
(11) HVI: semi-infinite target 半無限板への超高速衝突
(12) HVI: finite target 有限板への超高速衝突
(13) Hydrocode 数値解析法
(14) Scale Modeling スケーリング
Final Examination 期末試験
(15) Summary

3. Purpose
1. 歪み速度依存性を理解している
2. スポール破壊を理解している
3. 弾道限界曲線の特徴を理解している
4. 保存則ならびに Tate Model などの簡易モデルを理解している

4. Method of evaluation
Grade is evaluated by taking the score of short quiz and final examination into account.

5. Notification
各トピックに関して授業を行い、確認のための小テストを実施する
It is desirable or recommended for the students to take courses related to "Strength of Material", "Solid Mechanics" and so on in the undergraduate course.

6. Additional work
You should read distributed materials before the lecture and investigate some technical works which you cannot understand after the lecture.

7. Text book
None
Reference book
(1) Zukas et al, Impact Dynamics, KRIEGER, 1982
(2) Melosh, Impact Cratering, OXFORD, 1989

(3) Horie and Sawaoka, Shock Compression Chemistry of Materials, KTK Scientific Publishers, 1993
(4) Norman Jones, Structural Impact, Cambridge University Press, 1990
(https://doi.org/10.1017/CBO9780511624285)
(4) https://www.iadc-online.org/index.cgi?item=docs_pub

8. Key words

Hypervelocity Impact, Space Debris, Shock Wave

9. Email address

akahoshi.yasuhiro144@mail.kyutech.jp

Advanced Mechanics of Materials（材料力学特論）

Lecturer, Credit
YAMAGUCHI Eiki, Credit 2

1. Course Description
For a good prediction of structural behavior, the modeling of material behavior (stress-strain relationship) is very important. To this end, plasticity-based modeling of material behavior is studied in this course, One-dimensional modeling is first discussed, which is followed by the modeling of material behavior in multi-dimension. Specifically, the Mises type of material is picked out to illustrate the plasticity-based model. It is noted that this type of model is exclusively used in the analysis of steel structures.

2. Schedule
1. One-Dimensional Material Behavior and Simple Modeling
2. Plasticity-Based Modeling of One-Dimensional Material Behavior
3. Example Problem
4. Essentials of Stress
5. Essentials of Stress
6. Essentials of Strain
7. Essentials of Stress-Strain Relationship
8. Plasticity Theory in Multi-Dimension
9. Plasticity Theory in Multi-Dimension
10. Plasticity Theory in Multi-Dimension
11. Stress-Strain Relationship
12. Example Problem
13. Example Problem
14. Numerical Procedure
15. Example Problem

3. Purpose

4. Method of evaluation
Homework assignments and examinations

5. Notification
This lecture is given in English.

6. Additional work
It is required to understand thoroughly each lecture.

7. Text book and Reference book
Reference book:
Plasticity for Structural Engineers
Wai-Fah Chen and Da-Jian Han
J. Ross Publishing

8. Key words

9. Email address

Advanced Space Dynamics（スペースダイナミクス特論）

Lecturer, Credit
HIRAKI Koju, Credit 2

1. Course Description
物体の 3 次元空間における基本的な運動の力学について、宇宙機等を具体例として取り上げ、理解を深める。また、この科目は工学英語科目のため、英語で専門分野について理解を深めることを目的とする。
This course aims to promote the understandings of the basic formulations of two-body problems in three-dimensional coordinates, taking an artificial satellite and a spacecraft as examples. The lectures are given in English.

2. Schedule
（1）ケプラー軌道 Keplerian orbit
（2）楕円の性質 Elliptical orbit
（3）ケプラーの法則 Kepler's law
（4）ケプラーの方程式 Kepler's equation
（5）ケプラーの軌道要素 Oribital elements
（6）太陽系惑星の軌道計算 Orbits of planets in solar system
（7）地球固定座標への変換 Transformations to Earth-centered frames
（8）地球の形 Shape of Earth
（9）国際宇宙ステーションの軌道予測 Prediction of orbit of ISS
（10）国際宇宙ステーションの観測 Observation of ISS
（11）ホーマン軌道変換 Hohmann transfer
（12）惑星への到達軌道 Inerplanetary trajectory
（13）ロンチ・ウィンドウ Launch window
（14）深宇宙ミッションの設計 Design of trajectory of interplanetary travel
（15）近未来ミッションの創出 Creation of future mission

3. Purpose
1. 軌道要素を理解できる understand orbital elements
2. 軌道要素から人工衛星の位置を予測できる predict the positions of a satellite on the orbital element
3. ロンチ・ウインドウを理解できる understand a launch window

4. Method of evaluation
課題に対するレポートの提出、およびプレゼンテーションにより評価を行う。プレゼンテーションは日本語・英語のどちらで行ってよい。
Several assingments will be given. Students are required to submit documents for them. For some assingments students are requested to make presentations in front of attendee.

5. Notification
剛体の力学を含めた力学に関する知識、および宇宙工学に関する基本的な知識を有していることが望ましい。

6. Additional work
講義では出来る限り数学・物理の知識を補いながら説明するので、導出過程を自分で再現することが数学・物理の復習につながる。レポート課題は、講義に出てきた内容を組み合わせればできるものなので、復習を大事にすること。
The basics are given in the course. The assingments are achievable based on the knowledge given in the lectures.

7. Text book and Reference book
特に指定しない。

8. Key words

9. Email address
hiraki.koju735@mail.kyutech.jp

Advanced Embedded Systems（組み込みシステム特論）

Lecturer, Credit
ASAMI Kenichi, Credit 2

1. Course Description
This lecture provides the design methodology, operation principles, applications of embedded systems. Fundamentals of computer architecture, systems modeling languages, reconfigurable digital circuits, and fault tolerant systems will be introduced.

2. Schedule
(1) Embedded systems
(2) Computer architecture
(3) Memory architecture
(4) Input and output
(5) Multitasking
(6) Scheduling
(7) Modeling dynamic behaviors
(8) Finite state machines
(9) Unified modeling language
(10) Systems modeling language
(11) Reconfigurable digital circuits
(12) Hardware description language
(13) Fault Tolerant systems
(14) Presentation for designs
(15) Presentation for applications

3. Purpose

4. Method of evaluation
The grade is evaluated by mini-examinations, presentation, and final report.

5. Notification

6. Additional work
Students are required to prepare the lecture by the online text.

7. Text book
The online text will be provided on Moodle.

Reference book
1) Peter Marwedel, Embedded System Design 2nd Edition, Springer, 2011.
2) Sarah Harris, David Harris, Digital Design and Computer Architecture ARM Edition, Morgan Kaufmann, 2015.
3) Clive Maxfield, The Design Warrior's Guide to FPGAs, Newnes, 2004.

8. Key words

9. Email address

Energy Conversion and Plasma Physics（エネルギー工学特論）

Lecturer, Credit
TOYODA Kazuhiro, Credit 2

1. Course Description
Fluid dynamics and plasma physics are introduced for understanding energy conversion from electric enegy to kinetic energy employed in electric propulsion.

2. Schedule
1. Fluid dynamics1
2. Fluid dynamics2
3. Fluid dynamics3
4. Fluid dynamics4
5. Fluid dynamics5
6. Plasma physics1
7. Plasma physics2
8. Plasma physics3
9. Plasma physics4
10. Plasma physics5
11. Energy conversion from electric power to propulsion1
12. Energy conversion from electric power to propulsion2
13. Energy conversion from electric power to propulsion3
14. Energy conversion from electric power to propulsion4
15. Energy conversion from electric power to propulsion5

3. Purpose

4. Method of evaluation
Perticipation and weekly report

5. Notification

6. Additional work

7. Text book and Reference book
(1) J. D. Anderson: Modern Compressible Flow. (McGraw-Hill)
(2) F. F. Chen: Introduction to Plasma Physics and Controlled Fusion. (PLENUM)
(3) 栗木、荒川: 電気推進ロケット入門（東京大学出版会）

8. Key words

9. Email address

English XA（英語　ＸＡ）

Lecturer, Credit
RUXTON Ian, Credit 1

1. Course Description

To teach students how to write technical abstracts, and full research papers that meet global standards. Students will bring in content that is related to their thesis, and will learn to build up their academic writing ability. They will learn more technical terminology, and various aspects of how to best structure their academic paper and thesis. They will learn to summarize academic papers.

They will be exposed to spoken English (videos of lectures etc.) related to their research field.

* Intended for Japanese students of the Space Engineering International Course (SEIC).

2. Schedule

1. Course overview, summary and paraphrasing and avoiding plagiarism. Step-by-step introduction to characteristics of a good abstract.
2. Review of summarizing and paraphrasing; introduction to self- and peer-evaluation techniques; Abstract introduction and method. Homework as directed by the instructor: Summary of research.
3. Abstract discussion and conclusion. Turn in your study's summary.
4. Introduction to common errors
5. Presenting your research (1) (practice); Self-evaluation and goal setting; Editing.
6. Presenting your research (2); Peer-reviewing (structure, format and language conventions review).
7. Summarizing academic papers (1) Choosing an appropriate topic
8. Summarizing academic papers (2); Homework as directed by the instructor
9. Writing research introduction; Researching the topic background; Describing aims and writing good research questions; Write a summary about your study's introduction, literature, problem and research questions; Homework as directed by the instructor
10. Writing research method; Poster Session writing: Turn in summary of study's introduction.
11. Writing research results; Poster Session writing; Turn in summary of research method. Homework as directed by the instructor
12. Write the discussion and significance of your research results. How to present results; Poster writing, facts, details and delivery. Turn in summary of research results. Homework as directed by the instructor.
13. Writing research references and citations. Presenting your research (practice), as well as on student self-evaluation, goal setting, along with reviewing the fundamentals of abstract and academic writing. Turn in completed summary; Homework as directed by the instructor.
14. Presenting your research (1); Peer-editing (structure, format and language conventions review). Homework as directed by the instructor.
15. Peer-editing; Turn-in Final Paper
16. Final Exam and student survey

3. Purpose

1. Understand the basic conventions of an abstract
2. Understand how to concisely state research objectives, explain the research background, describe the research design and present results
3. Understand how to use appropriate register and tone for the specific genre of writing
4. Be able to write grammatically accurate sentences using appropriate vocabulary

4. Method of evaluation

20% Summary of Student's Study
20% Research Drafts
20% Teacher Discretion
40% Final Exam

5. Notification

All class sessions are conducted in English. This class has informal conversation, peer-assisted learning and writing practice.

6. Additional work

Active participation is expected in class activities. Students are expected to prepare for class warm-up each week and assist each other

7. Text book, reference book

Writing Research Papers (published by Macmillan)
English-English dictionaries will be helpful.

8. Key words

Descriptive writing, evaluation, cooperative / autonomous learning, creative process: brainstorming, organizing, drafting, reviewing, revising, publishing

9. Email address

Heat Transfer（熱輸送特論）

Lecturer, Credit
MIYAZAKI Koji, Credit 2

1. Course Description
In this class, we intend to teach an introductory heat transfer such as heat conduction, convective heat transfer, and radiative heat transfer. We teach a few simple numerical methods for heat transfer problems to understand the heat transfer.

* This class is scheduled for the students in the international space engineering course.

2. Schedule
(1) Modes of heat transfer
(2) Heat conduction, Thermal resistance model
(3) 1 Dimensional unsteady state heat conduction
(4) Unsteady state heat conduction, Heisler-type charts
(5) Numerical simulation for heat conduction
(6) Introduction to radiative heat transfer
(7) Radiative heat transfer, Shape factor
(8) Radiatvie heat transfer, Electrical network analogy
(9) Radiative heat transfer, Gray body
(10) Radiative heat transfer and Heat conduction
(11) Convection, Dimensional analysis
(12) Convective heat transfer
(13) Numerical simulation for convective heat transfer
(14) Turbulent convective heat transfer
(15) Applications (Heat pipes, Heat exchangers, Thermoelectric)

3. Purpose
1. Understanding of heat conduction
2. Understanding of radiative heat transfer
3. Understanding of convective heat transfer

4. Method of evaluation
Students will be evaluated by attendance reports, results of class assignments, and the results of a final assignment.

5. Notification
The students must have studied basic physics and computer programming for engineering.

6. Additional work

7. Text book
A.F. Mills, Heat Transfer, Prentice Hall
J. H. Lienhard, A Heat Transfer Textbook, Prentice Hall

Reference book
P.V. Bockh, T. Wetzel, Heat Transfer Basic and Practice, Springer

8. Key words

9. Email address
miyazaki.koji055@mail.kyutech.jp

High-speed Gas Dynamics（高速気体力学特論）

Lecturer, Credit
TSUBOI Nobuyuki, Credit 2

1. Course Description
Rockets, airplanes, and space vehicles fly under severe environments. The flight velocity changes fromsubsonic speed to supersonic and hypersonic speeds. The flight environment changes from a continuum regime to a low-density regime. This course presents fluid dynamics under such the flight environments of the space vehicles to understand the fundamental of the fluid dynamics.

2. Schedule
1. Introduction
2. Fundamental theory of compressible flow
3. Hypersonic gas dynamics
   (1) What is hypersonic low?
   (2)Experimental approach
   (3) Various approximate solution methods
   (4) Inviscid hypersonic flow
   (5)Viscous hypersonic flow
   (6)Real gas effects
   (7)Radiation
   (8)Wind tunnel testing for hypersonic flow
4. Rarefied gas dynamics
   (1)What is rarefied gas dynamics?
   (2)Feature of gas dynamics from microscopic view
   (3)Feature of gas under equilibrium state
   (4)Gas-surface interaction
   (5)Numerical simulation on rarefied gas dynamics

3. Purpose
1. 極超音速流れの概念を理解する.
2. 様々な近似解法を理解する.
3. 実在気体効果を理解する.
4. 希薄気体流を理解する.

4. Method of evaluation
Grade is evaluated by attendance of class, reports, and final examination.

5. Notification
It is desirable or recommended for the students to take courses related to “Fluid Dynamics”, “Compressible Fluid Dynamics” and so on in the undergraduate course.

6. Additional work
You should read distributed materials before the lecture and investigate some technical home works.

7. Text book
Distributed prints

References
(1)J.D.Andarson, Jr., Hypersonic and High Temperature Gas Dynamics, McGraw-Hill(1989)
(2)Bird, G.A., Molecular Gas Dynamics and the Direct Simulation of Gas Flow, Oxford(1994)
(3)日本機械学会 編, 原子・分子の流れ, 共立出版(1996)
(4)小林敏夫 編, 数値流体力学ハンドブック, 丸善(2003)

8. Key words

9. Email address
tsuboi@mech.kyutech.ac.jp

Introduction to Satellite Engineering（衛星工学入門）

Lecturer, Credit
CHO Mengu, Credit 2

1. Course Description
The purpose of this lecture is to provide an overview of satellite engineering with its emphasis on micro- and nano-satellite technologies and systems engineering approach such as verification and test.

2. Schedule
1. Introduction
2. Propulsion Basics
3. Propulsion System
4. Orbital Mechanics
5. Mission Analysis part.1
6. Mission Analysis part.2
7. Mission Analysis (constellation)
8. Electrical Power Systems
9. Prelaunch Environment and Spacecraft Structures
10. Spacecraft Dynamics and Attitude Control part.1
11. Spacecraft Dynamics and Attitude Control part.2
12. Thermal Control
13. Communication part.1
14. Communication part.2
15. Small Satellite Engineering

3. Purpose

4. Method of evaluation
Home works and discussion in the class

5. Notification
This lecture is provided in English. It is desirable for students to take Spacecraft Environmental Interaction Engineering (宇宙環境技術特論) as well.

6. Additional work
Download and read the lecture material before each lecture.

7. Text book and Reference book
Textbook
1. Spacecraft Systems Engineering, edited by Peter Fortescue et al., Wiley
Reference book
2. Space Mission Analysis and Design, Third Edition, edited by James Werts and Wiley Larson, Space Technology Library
3. Space Vehicle Design, second edition, Michael Griffin and Jame French, AIAA

8. Key words

9. Email address

Japanese for Beginners（日本語入門）

Lecturer, Credit
ISHIKAWA Tomoko, Credit 1

1. Course Description
This course is for international students of the Space Engineering International Course only. The purposes of the course are (1) to get used to Japanese phoneme system, (2) to master basic Japanese sentence patterns and vocabulary, (3) to be able to speak simple Japanese and (4) to master HIRAGANA and KATAKANA

2. Schedule
(1) Basic greeting expressions and self introduction
(2) Counting system and time-measuring system
(3) Sentences using nouns
(4) Numeral and Japanese counter words
(5) Shopping conversation
(6) Sentences to express existence
(7) Expressions of dates and periods of time
(8) Review
(9) Introduction of basic verbs
(10) Sentences using verbs
(11) Conversation using basic verbs (non-past)
(12) Conversation using basic verbs (past)
(13) Two types of adjectives and their usage
(14) Introduction of "Te-form"
(15) Sentences using "Te-form"
(16) Review and Test

3. Purpose
1. to get used to Japanese phoneme system,
2. to master basic Japanese sentence patterns and vocabulary
3. to be able to speak simple Japanese

4. Method of evaluation
Class participation, assignments, the final written and oral tests

5. Notification
We will use a romanized Japanese textbook and concentrate on developing the basic hearing and speaking abilities required in daily life.

6. Additional work
Do every assignment and review the lesson.

7. Text book
(1) Textbook: Beginner's Japanese for KIT Foreign Students
(2) Exercise book: Exercise Book of Beginner's Japanese for KIT Students
Reference: Nihongo Kiite Hanashite (The Japan Times)

8. Key words

9. Email address

Satellite Power System Ⅰ（衛星電力システム特論Ⅰ）

Lecturer, Credit

CHO Mengu, IMAIZUMI Misturu, KAWAKITA Shirou, NOZAKI Yukishige, Credit 1

1. Course Description

Power system is one of the most important subsystems to determine the fate of satellite mission. Without power, a satellite is useless. This lecture provides introduction of satellite power system from individual elements to overall pictures, as well as future prospect.

2. Schedule

1. Architecture of electrical power system
2. Photovoltaic-Battery System
3. Power system design
4. Solar cell principle
5. Space solar cell state-of-art
6. Environmental effect
7. Environmental effect
8. Solar array system

3. Purpose

4. Method of evaluation

Reports and mini tests

5. Notification

This lecture is provided in English. It is desirable for students to take Space Systems Engineering (宇宙システム工学) and/or Introduction to Satellite Engineering (衛星工学入門) as well. It is strongly recommended to take Satellite Power System B with this subject.

6. Additional work

Read a paper listed as reference during each lecture

7. Text book and Reference book

Reference book;
Spacecraft Power Systems by Mukun R. Patel, CRC Press, 2005

8. Key words

9. Email address

Satellite Power System II（衛星電力システム特論 II）

Lecturer, Credit

CHO Mengu, NAITOU Hitoshi, KUSAWAKE Hiroaki, Credit 1

1. Course Description

Power system is one of the most important subsystem to determine the fate of satellite mission. Without power, a satellite is useless. This lecture provides introduction of satellite power system from individual elements to overall pictures, as well as future prospect.

2. Schedule

1. Battery
2. Space battery state-of-art
3. Battery safet
4. Power control algorithm
5. Power control hardware
6. Reliability
7. High voltage power system
8. Small satellite power system

3. Purpose

4. Method of evaluation

Reports and mini tests

5. Notification

This lecture is provided in English. It is desirable for students to take Space Systems Engineering (宇宙システム工学) and/or Introduction to Satellite Engineering (衛星工学入門) as well. It is strongly recommended to take Satellite Power System I before taking this subject.

6. Additional work

Read a paper listed as reference during each lecture

7. Text book and Reference book

Reference book;
Spacecraft Power Systems by Mukun R. Patel, CRC Press, 2005

8. Key words

9. Email address

Space Environment Testing（宇宙環境試験）

Lecturer, Credit
CHO Mengu, Credit 2

1. Course Description
A satellite is exposed to extreme environments such as vacuum, radiation and plasma. It is also exposed to severe vibration and shock onboard a rocket. Satellites have to operate maintenance-free and need to be tested thoroughly before the launch. The purpose of the lectures is to understand from the basics about necessity, background of test levels and conditions, judgment criteria of each test.

2. Schedule
1. Space environment tests, why necessary?
2. Satellite development and test strategy
3. Vibration test principle
4. Vibration test methods and analysis
5. Shock test principle
6. Shock test and analysis
7. Thermal vacuum test principle
8. Thermal vacuum test method and analysis
9. Thermal vacuum or thermal cycle
10. Antenna and communication test
11. EMC test
12. Outgas test
13. Radiation test
14. Radiation test
15. Test standard

3. Purpose

4. Method of evaluation
Reports and mini-test

5. Notification
This lecture is provided in English. It is desirable for students to take space system related subjects, such as Space Systems Engineering and Introduction to Satellite Engineering. Also, laboratory workshop will be held in Space Environment Testing Workshop

6. Additional work
Download and read the lecture material before each lecture.

7. Text book and Reference book
References:
HARRIS' SHOCK AND VIBRATION HANDBOOK, Allan G. Piersol, Thomas L Paez, Macgrawhill,
Spacecraft Thermal Control Handbook, David G. Gilmore, Aerospace Press
JAXA-JERG-2-130「宇宙機一般試験標準」
SMC-S-016 "TEST REQUIREMENTS FOR LAUNCH, UPPER-STAGE AND SPACE VEHICLES"
ISO-15864 " Space systems — General test methods for space

8. Key words

9. Email address

Space Systems Engineering I（宇宙システム工学Ⅰ）

Lecturer, Credit
SHIRAKI Kuniaki, Credit 1

1. Course Description
We study the space systems engineering referring to spacecraft as an example. It covers the mission analysis and design, system design approach, systems engineering process and methodology, and management needed for space development.

2. Schedule
1. Systems Engineering Process
2. Space Mission Geometry
3. Astrodynamics (1of2)
4. Astrodynamics (2of2)
5. Orbit and Constellation Design
6. Spacecraft Design and Sizing
7. Spacecraft Design and Sizing
8. Spacecraft Environment

3. Purpose

4. Method of evaluation
Homeworks

5. Notification
This lecture is provided in English. It is desirable for students to take “Introduction to Satellite Engineering”. It is strongly recommended to take “Space Systems Engineering I I” with this subject.

6. Additional work
Download and study the lecture material before each lecture.

7. Text book and Reference book
References
1. Applied Space Systems Engineering, edited by W.J.Larson et al., Space Technology Library.
2. Space Mission Analysis and Design, edited by J.R.Wertz and W.J. Larson. Space Technology Library.
3. Spacecraft Systems Engineering, edited by Peter Fortescue et al., Wiley

8. Key words

9. Email address

Space Systems Engineering I（宇宙システム工学Ⅰ）

Lecturer, Credit
SHIRAKI Kuniaki, Credit 1

1. Course Description
We study the space systems engineering referring to spacecraft as an example. It covers the mission analysis and design, system design approach, systems engineering process and methodology, and management needed for space development.

2. Schedule
1. Space Propulsion Systems
2. Spacecraft Computer Systems and Software
3. Space Payload Design and Sizing
4. Communications Architecture
5. Mission Operations
6. Ground System Design and Sizing
7. Spacecraft Manufacturing and Test
8. Cost Modelling

3. Purpose

4. Method of evaluation
Homeworks

5. Notification
This lecture is provided in English. It is desirable for students to take "Introduction to Satellite Engineering". It is strongly recommended to take "Space Systems Engineering I" before taking this subject.

6. Additional work
Download and study the lecture material before each lecture.

7. Text book and Reference book
References
1. Applied Space Systems Engineering, edited by W.J.Larson et al., Space Technology Library.
2. Space Mission Analysis and Design, edited by J.R.Wertz and W.J. Larson. Space Technology Library.
3. Spacecraft Systems Engineering, edited by Peter Fortescue et al., Wiley

8. Key words

9. Email address

Spacecraft Environment Interaction Engineering（宇宙環境技術特論）

Lecturers, Credit

CHO Mengu, AKAHOSHI Yasuhiro, TOYODA Kazuhiro, KIMOTO Yugo, KOGA Seiichi, Credit 2

1. Course Description

A spacecraft must withstand the severe space environment which is widely different from the ground. The purpose of this class is to understand special characteristics of space environment, and to learn the basic knowledge needed to develop technologies against space environment.

2. Schedule

Syllabus outline：

1. Space environment
2. Spacecraft charging and discharge
3. Space debris
4. Spacecraft charging analysis
5. ESD ground test of spacecraft
6. Space environment measurement

3. Purpose

4. Method of evaluation

Report

5. Notification

Students should be well informed about space engineering.

6. Additional work

7. Reference book

(1) D. E. Hastings and H. Garret, Spacecraft Environment Interaction, Cambridge University Press

8. Key words

9. Email address

Spacecraft Environment Testing Workshop（宇宙環境試験ワークショップ）

Lecturer, Credit
CHO Mengu, Credit 1

1. Course Description
A satellite is exposed to extreme environments such as vacuum, radiation and plasma. It is also exposed to severe vibration and shock onboard a rocket. Satellites have to operate maintenance-free and need to be tested thoroughly before the launch. The purpose of this subject is to learn the actual tests through hands-on laboratory workshop.

2. Schedule
1. Vibration - overview
2. Vibration - preparation
3. Vibration test
4. Vibration - analysis
5. Shock - overview
6. Shock - preparation
7. Shock test
8. Shock - analysis
9. Thermal vacuum - overview
10. Thermal vacuum - preparation
11. Thermal vacuum test
12. Thermal vacuum - analysis
13. Thermal cycle overview and preparation
14. Thermal cycle test
15. Thermal cycle - analysis

3. Purpose

4. Method of evaluation
Report

5. Notification
This workshop is for students who register the Space Engineering International Course only. Students are supposed to finish Space Environment Testing.

6. Additional work
Download and read the lecture material before each lecture.

7. Text book and Reference book
References:
HARRIS' SHOCK AND VIBRATION HANDBOOK, Allan G. Piersol, Thomas L Paez, Macgrawhill,
Spacecraft Thermal Control Handbook, David G. Gilmore, Aerospace Press
JAXA-JERG-2-130「宇宙機一般試験標準」
SMC-S-016 "TEST REQUIREMENTS FOR LAUNCH, UPPER-STAGE AND SPACE VEHICLES"
ISO-15864 " Space systems — General test methods for space craft, subsystems and units"
ECSS-ST-10-03 "Space Engineering – Testing"

8. Key words

9. Email address

Spacecraft System Thermal Control（宇宙システム熱工学特論）

Lecturer, Credit
OKUYAMA Keiichi, Credit 2

1. Course Description
Spacecraft are required to endure severe environment such as micro-gravity, extreme vacuum, big temperature change, radiation and so on. Development of spacecraft requires broad knowledge of various fields. In this lecture, students will learn in what process spacecraft are designed, developed and operated in the viewpoint of thermal control engineering.
This Lecture focuses on general concepts applicable to various spacecraft designs but reinforce ideas with real failure examples.

2. Schedule
(1) Course introduction
(2) Spacecraft thermal environment 1
(3) Spacecraft thermal environment 2
(4) Thermodynamics 1
(5) Thermodynamics 2
(6) Heat transfer engineering 1
(7) Heat transfer engineering 2
(8) Spacecraft thermal control design philosophy 1
(9) Spacecraft thermal control design philosophy 2
(10) Outline of Spacecraft thermal control design, Midterm review (Midterm Exam)
(11) Temperature analysis of micro satellite 1
(12) Temperature analysis of micro satellite 2
(13) Thermal vacuum test of micro satellite
(14) Heat shield system of atmospheric re-entry vehicle 1
(15) Heat shield system of atmospheric re-entry vehicle 2

3. Purpose

4. Method of evaluation
It will be described in the first lecture.

5. Notification

6. Additional work
You must read a distributed document before you participate in a lecture.
Furthermore, you are given a problem at the lecture end, must make a report in reference to lecture contents and the distributed document.

7. Text book and Reference book
It will be described in the first lecture.

8. Key words

9. Email address