Space Engineering International Course
Syllabus 2020

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.
Students are expected to set aside 0.5 hours a week as time for class preparation.

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
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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 purpose 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

Students are expected to set aside 30 minutes a week as time for class preparation..
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

Space 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 and Purpose**
   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. Method of evaluation
Report

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

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

6. 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"

7. Key words

8. Email address

Space Systems PBL I（宇宙システム PBL Ⅰ）

Lecturer, Credit
CHO Mengu, Credit 1

Space Systems PBL Ⅱ （宇宙システム PBL Ⅱ）

Lecturer, Credit
CHO Mengu, Credit 1

1. **Course Description**
   Space system spans a wide range of fields such as mechanical, electrical, material and other engineerings and consists of a huge number of parts and numerous softwares, It is also required to function maintenance-free for a long time in the extreme environment in space. A satellite flies over any countries regardless the border. Therefore, its usage requires a global point of view. It is not sufficient to learn via textbooks and lectures, in order to learn how to design the system elements, combine them, test and operate to bring the satellite value to the users. Students carry out a project in a group made of a few numbers to develop hypothetical space system or real nano-satellite, rocket, spacecraft and others. Students organize the user requirements and perform system conceptual design by incorporating them into the system requirements and the design requirements. This PBL will be conducted in English as a subject of Space Engineering International Course.

2. **Schedule**
   To be announced by the project supervisors.

3. **Text book and Reference book**
   To be announced for each project.

Thesis Research for Degree（工学講究）

Lecturer, Credit
Primary supervisor, Credit 2

Course Description

In the course of writing a master's thesis, students will be instructed on research plans, methods of research, and how to summarize research results regarding the master thesis subject. The course will guide students to write theis writing focusing thesis organization, research planning, problem solving methods, summarizing the results.

Special Laboratory Work（工学特別実験）

Lecturer, Credit
Primary supervisor, Credit 1

Course Description

In the course of writing a master's thesis, students will be instructed on research plans, methods of research, and how to summarize research results regarding the master thesis subject. The course will guide students to do laboratgory works regarding data management, safety, experimental practice and other practical aspects of the research.

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 design methodology, working principles, and organization of embedded systems. Fundamentals of computer architecture, digital circuits, and systems modeling languages will be introduced.

2. Schedule

   (1) Embedded systems
   (2) Logic circuits (1)
   (3) Logic circuits (2)
   (4) Verilog HDL (1)
   (5) Verilog HDL (2)
   (6) FPGA (1)
   (7) FPGA (2)
   (8) ARM microprocessor (1)
   (9) ARM microprocessor (2)
   (10) UML/SysML (1)
   (11) UML/SysML (2)
   (12) SystemC (1)
   (13) SystemC (2)
   (14) Presentation (1)
   (15) Presentation (2)

3. Purpose

   1. Students expand understanding of embedded systems design.
   2. Students enhance understanding of digital systems development.
   3. Students utilize understanding of systems modeling languages.

4. Method of evaluation

   The grade is evaluated by mini-tests, presentation, and final report.

5. Notification

   Students are required to review the lecture slides.

6. Additional work

   Students are expected to set aside 4 hours a week as time for class preparation.

7. Text book

   The lecture slides will be provided on Moodle.

   Reference book

   [1] Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design 2nd Edition, Morgan Kaufmann, 2008.
   [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

   Embedded systems, FPGAs, ARM microprocessor, UML/SysML, SystemC

9. Email address

Advanced Mechanics of Materials（材料力学特論）

Lecturer, Credit
YAMAGUCHI Eiki, Credit 2

1. Course Description and Purpose

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.

2. Schedule

1. One-Dimensional (1D) Material Modeling
2. Plasticity-Based Modeling of 1D
3. Plasticity-Based Modeling of 1D
4. Example Problem
5. Essentials of Stress
6. Essentials of Stress
7. Essentials of Strain
8. Essentials of Stress-Strain Relationship
9. Plasticity Theory in Multi-Dimension
10. Plasticity Theory in Multi-Dimension
11. Plasticity Theory in Multi-Dimension
12. Stress-Strain Relationship
13. Stress-Strain Relationship
14. Example Problem
15. Example Problem

3. Method of evaluation

Examinations

4. Notification

5. Additional work

It is required to understand thoroughly each lecture.
Students are expected to study for 4 hours a week for this coursein in addition to the lectures.

6. Text book and Reference book

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

7. Key words

8. Email address

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. 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 analysis
(9) Cable structure (Part 1): 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): 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

The acquisition of the fundamentally advanced knowledge:

1. Nonlinear analysis of space frames and mechanical structures
2. Structural analysis of cable structures
3. Elasto-plastic analysis of building and mechanical structures

4. Method of evaluation

The overall Credits 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 spend more than 7 hours and 30 minutes to study the concerning knowledge and review the 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

Nonlinear analysis, Buckling analysis, Space frames, Elasto-plastic analysis

9. Email address

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High-speed Gas Dynamics（高速気体力学特論）

Lecturer, Credit

TSUBOI Nobuyuki, Credit 2

1. Course Description and Purpose

Rockets, airplanes, and space vehicles fly under severe environments. The flight velocity changes from subsonic 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. Method of evaluation

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

4. 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.

5. Additional work

You should read distributed materials before the lecture and investigate some technical home works. Students are expected to set aside 4 hours a week as time for class preparation.

6. 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)

7. Key words

Hypersonic Flow, Compressible Flow, Reentry, Rarefied Gas Flow

8. Email address

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Advanced Space Robotics（宇宙ロボティクス特論）

Lecturer, Credit

NAGAOKA Kenji, Credit 2

1. Course Description and Purpose

Currently, robotics technologies have been required for various space applications to support or replace human space activities. In particular, robotics exploration is necessary for deep space exploration. This course introduces fundamentals and applications of space robotics. Specifically, this course expects students of learning and better understanding of fundamental mechanics, control technique, and autonomous technology of space robotics.

2. Schedule

1. Introduction of Space Robotics
2. Kinematics and Dynamics of Space Manipulator
3. Control of Space Manipulator
4. Contact Dynamics of Space Manipulator
5. Object Capture by Space Manipulator
6. Vibration Suppression Control of Flexible Space Structure
7. Tele-Operation Technology and Autonomy
8. Locomotion Mechanism of Planetary Robot
9. Terramechanics for Planetary Robotics (1)
10. Terramechanics for Planetary Robotics (2)
11. Autonomous Technology for Planetary Robotics (1)
12. Autonomous Technology for Planetary Robotics (2)
13. Robotics for Minor Body Exploration
14. Drilling Technology on Extraterrestrial Body
15. Backup and Introduction of State-of-the-Art Topics

3. Method of evaluation

Comprehensive evaluation of attendance and reporting assignments.

4. Notification

This lecture is provided in English. It is desirable for students to have fundamentals of robotics and control engineering.

5. Additional work

Four-hour-a-week of self-learning for preparation based on the lecture materials and reference books.

6. Text book

N/A.

References

[1] Y. Xu and T. Kanade, Space Robotics: Dynamics and Control, Kluwer Academic Publishers.
[2] A. Elley, An Introduction to Space Robotics, Springer.
[3] J. Y. Wong, Theory of Ground Vehicles, Wiley.
[4] G. H. Heiken et al., Lunar Sourcebook: A User's Guide to the Moon, Cambridge University Press.

7. Key words

Robotics, Control Engineering, Space Technology, Contact Dynamics, Terramechanics

8. Email address

nagaoka.kenji572@mail.kyutech.jp

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

Lecturer, Credit
AKAHOSHI Yasuhiro, Credit 2

1. Course Description and Purpose

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
(2) Introduction of low, high, hypervelocity impact
(3) Fundamental relationships(1)
(4) Fundamental relationships(2)
(5) Material response(1:metals and ceramics)
(6) Material response(2:composites)
(7) Impedance
(8) Non-penetrating impacts
(9) Strength Effect
(10) Tate model
(11) HVI: semi-infinite target
(12) HVI: finite target
(13) Hydrocode
(14) Scale Modeling/Final Examination
(15) Summary

3. Method of evaluation

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

4. Notification

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.

5. Additional work

Students are expected to set aside 4 hours a week as time for class preparation.

6. 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)

7. Key words

Hypervelocity Impact, Space Debris, Shock Wave

8. Email address

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Advanced Space Dynamics（スペースダイナミクス特論）

Lecturer, Credit

HIRAKI Koju, Credit 2

1. Course Description and Purpose

   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）Keplerian orbit
   （２）Elliptical orbit
   （３）Kepler's law
   （４）Kepler's equation
   （５）Oribital elements
   （６）Orbits of planets in solar system
   （７）Transformations to Earth-centered frames
   （８）Shape of Earth
   （９）Prediction of orbit of ISS
   （１０）Observation of ISS
   （１１）Hohmann transfer
   （１２）Inerplanetary trajectory
   （１３）Launch window
   （１４）Design of trajectory of interplanetary travel
   （１５）Creation of future mission

3. Method of evaluation

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.

4. Notification

5. Additional work

The basics are given in the course. The assingments are achievable based on the knowledge given in the lectures. Students are expected to set aside 4hours a week as time for class preparation.

6. Text book and Reference book

Not specified

7. Key words

8. Email address

hiraki.koju735@mail.kyutech.jp

Heat Transfer（熱輸送特論）

Lecturer, Credit
MIYAZAKI Koji, Credit 2

1. Course Description and Purpose

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. Method of evaluation

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

4. Notification

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

5. Additional work

Students are expected to set aside 4 hours a week as time for class preparation.

6. 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

7. Key words

8. Email address

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Introduction to Satellite Engineering（衛星工学入門）

Lecturer, Credit

CHO Mengu, Credit 2

1. Course Description and Purpose

   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. Method of evaluation

Home works and discussion in the class

4. 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.

5. Additional work

Download and read the lecture material before each lecture.

Students are expected to set aside 4 hours a week as time for class preparation.

6. Text 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

7. Key words

8. Email address

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

Lecturer, Credit

CHO Mengu, NOZAKI Yukishige, OKUMURA Teppei, Credit 1

1. Course Description and Purpose

   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. Method of evaluation

   Reports and mini tests

4. 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 Ⅱ with this subject.

5. Additional work

   Read a paper listed as reference during each lecture.
   Students are expected to set aside 2 hours a week as time for class preparation.

6. Text book and Reference book

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

7. Key words

8. 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 and Purpose**

   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. **Method of evaluation**

   Reports and mini tests

4. **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.

5. **Additional work**

   Read a paper listed as reference during each lecture.
   Students are expected to set aside 2 hours a week as time for class preparation.

6. **Text book and Reference book**

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

7. **Key words**

8. **Email address**

Space Environment Testing（宇宙環境試験）

Lecturer, Credit

CHO Mengu, Credit 2

1. Course Description and Purpose

   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. Method of evaluation

   Reports and mini-test

4. 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

5. Additional work

   Download and read the lecture material before each lecture.
   Students are expected to set aside 4 hours a week as time for class preparation.

6. 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

7. Key words

8. Email address

Spacecraft Structure and Material（宇宙構造材料特論）

Lecturer，Credit

OKUYAMA Keiichi, Credit 2

1. Course Description and Purpose

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 structural dynamics and material mechanics.

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 environment 1
(3) Spacecraft environment 2
(4) Strength of Materials 1
(5) Strength of Materials 2
(6) Spacecraft structure design philosophy 1
(7) Spacecraft structure design philosophy 2
(8) Outline of Spacecraft structure design, Midterm review (Midterm Exam)
(9) Materials 1
(10) Materials 2
(11) Strength and stiffness analysis
(12) Approximation of natural frequencies
(13) Random vinration response analysis
(14) Shock response analysis
(15) Temperatures analysis and thermal elastic stress analysis, Final review (Final exam.)

3. Method of evaluation

It will be described in the first lecture.

4. Notification

This lecture is provided in English. It is desirable for students to take the strength of structures (構造力学) or the material Strength (材料力学) in your bachelor's degree course.

5. 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.

Students are expected to set aside 4 hours a week as time for class preparation.

6. Text book and Reference book

Text book: Spacecraft Structures and Materials, K. Okuyama (to be published in FY2018.)

Reference book: Spacecraft Structures, edited by Wijker, J. Jaap, Springer.

Reference book: Structural Analysis by O. A. Bauchau and J. I. Craig Wijker, Springer.

7. Key words

8. 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 and Purpose

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. Method of evaluation

It will be described in the first lecture.

4. Notification

5. 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.

6. Text book and Reference book

It will be described in the first lecture.

7. Key words

8. Email address

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

Lecturer, Credit

MIHARA Shoichiro, Credit 1

1. Course Description and Purpose

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. Method of evaluation

Homeworks

4. 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.

5. Additional work

Download and study the lecture material before each lecture.

Students are expected to set aside 2 hours a week as time for class preparation.

6. 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

7. Key words

8. Email address

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

Lecturer, Credit

MIHARA Shoichiro, Credit 1

1. Course Description and Purpose

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. Method of evaluation

Homeworks

4. 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.

5. Additional work

Download and study the lecture material before each lecture.
Students are expected to set aside 2 hours a week as time for class preparation.

6. 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

7. Key words

8. 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 and Purpose

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. Method of evaluation

Report

4. Notification

Students should be well informed about space engineering.

5. Additional work

Students are expected to set aside 4hours a week as time for class preparation.

6. Text book and Reference book

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

7. Key words

8. Email address

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

Lecturer，Credit

TOYODA Kazuhiro, Credit 2

1. Course Description and Purpose

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. Method of evaluation

Perticipation and weekly report

4. Notification

5. Additional work

Students are expected to set aside 4hours a week as time for class preparation.

6. Text book and Reference book

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）

7. Key words

8. Email address

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