JYPE 2015-2016
Fall Semester
Course Description

Tohoku University
Institute for Excellence in Higher Education

Contents

Detailed Course Description

Japanese 1

Instructor: Associate Professor Wataru Nakamura and staffs

Offices: Nakamura: Rm 523, Institute for Excellence in Higher Education Building
(Kawakita Joint Building)

Other staffs: Rm 106, International Exchange Building

Contact e-mail address: jlptohoku@gmail.com

Japanese 1 is for novice learners. When you successfully complete the course, you can expect to pass Level 5 (N5) of the Japanese Language Proficiency Test (http://www.jlpt.jp/). The course begins with the study of hiragana, katakana and pronunciation and then covers all 25 Lessons of "Minna no Nihongo I" published by 3A Network. The course grade will be based on attendance, participation and in-class quizzes (50%) and the final examination (50%).

[Oct 1 (Thr) Registration & Placement test]

01. OCT 5 (Mon) HIRAGANA

02. OCT 8 (Thr) L.1-1

...wa...desu.

03. OCT 15 (Thr) L.1-2 / L.2

...wa...ja arimasen. S+*ka*?

Kore/sore/are Soodesu Sooja arimasen

After October 15, the classes will be held on every Monday and Thursday (except a few national holidays and winter vacation) and each class will generally cover 1 lesson. The schedule below is subject to change.

04. OCT 19 (Mon) L.3 ～ JAN 21 (Thr) L.25

L.3

Koko/soko/asoko *Doko/dochira* N *no* N

L.4

Ima ...ji ...fun desu V-*masu*
masu/mashita/masen/masendeshita *...kara...made* N *to* N S+*ne*

L.5

N(place) *e ikimasu* *Doko e mo ikimasen* N(vehicle) *de ikimasu* *Itsu* S+*yo*

L.6

...o V *...o shimasu* *Nani o shimasu ka* N(place) *de* V V *masen ka* V *mashoo*

L.7

N(tool/means) *de* V N(person) *ni agemasu* N(person) *ni moraimasu* *Moo* V *mashita.*

L.8

N *wa na*-adj *desu* N *wa i*-adj *desu* *Totemo* *Amari* N *wa doodesu ka* N1 *wa donna* N2 *desu ka* S1 *ga* S2 *Dore*

L.9

N *ga arimasu* N *ga wakarimasu* N *ga sukidesu* *Donna* N *Yoku* *Daitai* *Takusan* *Sukoshi* *Amari* *Zenzen* S1 *kara* S2 *Dooshite*

L.10

N *ga arimasu/imasu* N1(place) *ni* N2 *ga arimasu/imasu* N1 *wa* N2(place) *ni arimasu/imasu* N1(thing/person/place) *no* N2(position) N1 *ya* N2

L.11

Numbers　Quantifier(period)*ni ...kai*　Quantifier *dake*/N *dake*

L.12

Past tense of noun sentences and *na*-adjective sentences　Past tense of *i*-adjective sentences　N1 *wa* N2 *yori* adj *desu*　N1 *to* N2 *to dochira no hoo ga* adjective *desu ka*　N1 *no naka de dore ga ichiban* adjective *desu ka*

L.13

N *ga hoshii desu*　V *masu*　V *tai desu*　N(place) *e* V *masu*-form *ni ikimasu*　*Dokoka/nanika*

L.14

verb conjugation　Verb groups　Verb *te*-form　Verb *te*-form *kudasai*　V *te*-form *imasu*　V *masu*-form *mashoo ka*　S1 *ga*, S2

L.15

V *te*-form *mo ii desu*　V *te*-form *wa ikemasen*　V *te*-form *imasu*　V *te*-form *imasu*

L.16

V *te*-form, [V *te*-form], ...　V1 *te*-form *kara*, V2　N1 *wa* N2 *ga*　adjective　*Dooyatte Dono* N

L.17

V *nai*-form　V *nai*-form *kudasai*　V *nai*-form *nakereba narimasen*　V *nai*-form *nakutemo ii desu*　N *made ni*

L.18

Verb dictionary form　N/V dictionary form *koto ga dekimasu*　*Watashi no shumi wa* N/V dictionary form *koto desu*　V1 dictionary form *mae ni* V2　*Nakanaka Zehi*

L.19

Verb *ta*-form　V *ta*-form *koto ga arimasu ka*　V *ta-ri*, V *ta-ri shimasu*　*i*-adj *ku narimasu*　*na*-adj/N *ni narimasu*　*Soodesu ne*

L.20

Polite style and plain style　Conversation in the plain style

L.21

plain form *to omoimasu*　S/plain form *to iimasu*　plain form *deshoo*　N1(place) *de* N2 *ga arimasu*　N(occasion) *de*

L.22

Noun modification　Noun modification by sentences

L.23

...toki, ...　V dictionary form/V *ta*-form *toki*　V dictionary form *to*, ...　N *ga* adjective/V

L.24

Kuremasu　V *te*-form *agemasu/moraimasu/kuremasu*　V *te*-form *moraimasu*　V *te*-form *kuremasu*　N(person) *ga* V　Interrogative *ga* V

L.25

V *ta*-form *ra*, ...　*...kute mo*　*...demo*　*Moshi*　*Ikura ...temo/demo*

05. JAN 25 (Mon)　EXAMINATION

Japanese 2

Instructor: Associate Professor Wataru Nakamura and staffs

Offices: Nakamura: Rm 523, Institute for Excellence in Higher Education Building
(Kawakita Joint Building)

Other staffs: Rm 106, International Exchange Building

Contact e-mail address: jlptohoku@gmail.com

Japanese 2 is for those who have finished Japanese 1 or those who have equal proficiency (i.e., Level II according to the placement test for JAPANESE LANGUAGE PROGRAM AT KAWAUCHI). When you successfully complete this course, you can expect to pass Level 4 (N4) of the Japanese Language Proficiency Test (http://www.jlpt.jp/). The course covers all 25 Lessons of "Minna no Nihongo II" published by 3A Network. The course grade will be based on attendance, participation and in-class quizzes (50%) and the examinations (50%).

[Oct 1 (Thr) Registration & Placement test]

The classes will be held on every Monday and Thursday (except a few national holidays and winter vacation) and each class will generally cover 1 lesson. The schedule below is subject to change.

01. OCT 5 (Mon) L.26 ～ NOV 16 (Mon) L.37

L.26

...n desu V *te*-form *itadakemasen ka* Interrogative V *ta*-form *ra ii desu ka* *..wa suki/kirai/joozu/heta desu*

L.27

Potential verbs *Miemasu* *Kikoemasu* *Dekimasu* *wa/mo/shika*

L.28

V1 *masu*-form *nagara* V2 V *te*-form *imasu* plain form *shi, ...* *Soreni* *Sorede*

L.29

V *te*-form *imasu*　N *ga* V *te*-form *imasu*　N *wa* V *te*-form *imasu*　V *te*-form *shimaimashita*　*Dokokani*　*Dokokade*

L.30

V *te*-form *arimasu*　N1 *ni* N2 *ga* V *te*-form *arimasu*　N2 *wa* N1 *ni* V *te*-form *arimasu*　V *te*-form *okimasu*　V *te*-form *okimasu*　*Mada* V(affirmative)

L.31

Volitional form　V volitional form *to omotte imasu*　V dictionary form *tsumori desu*　V *nai*-form *tsumori desu*　V dictionary form/N *yotee desu*　*Mada* V *te*-form *imasen*

L.32

V *ta*-form *hoo ga ii desu*　V *nai*-form *hoo ga ii desu*　*...deshoo*　*...kamoshiremasen*　*Kitto*　*Tabun*　*Moshikashitara*

L.33

Imperative and prohibitive forms　*...to yomimasu*　*...to kaite arimasu*　X *wa* Y *to yuu imi desu*　S/plain form *to itte imashita*　S/plain form *to tsutaeteitadakemasen ka*

L.34

V1 *toori ni* V2　N *no toori ni* V　V1 *ta*-form *ato de*, V2　N *no atode* V　V1 *te*-form V2　V1 *nai*-form *naide* V2

L.35

Conditional form　*...to*　*...tara*　N *nara*　*...hodo ...*

L.36

...yoo ni V　*...yoo ni narimasu.*　*...yoo ni shimasu*

L.37

Passive verbs　N1(person1) *wa* N2(person2) *ni* V passive　N1(person1) *wa* N2(person2) *ni* V passive　N(thing) *ga/wa* V passive　N1 *wa* N2(person) *ni yotte* V passive

02. NOV 19 (Thr)　MIDTERM EXAMINATION

03. NOV 26 (Thr) L.38 ～ JAN 21 (Thr) L.50

L.38

V plain form *no wa/ga/o* ...　... *tokimo/tokiya/tokino/tokini*

L.39

V *te*-form, ...　V *nai*-form *nakute*, ... *i*-adj *kute*, ...　*na*-adj *de*, ...　...*node*, ...

L.40

Interrogative V/*i*-adj/*na*-adj/N plain form *ka*, ...　... *ka doo ka*, ...　V *te*-form *mimasu*

L.41

N1 *ni* N2 *o yarimasu*　N1 *ni* N2 *o itadakimasu*　N *o kudasaimasu*　V *te*-form *yarimasu*　V *te*-form *itadakimasu*　V *te*-form *kudasaimasen ka*　N *ni* V

L.42

... *tame ni*, ...　V dictinary form *no ni* ...

L.43

V *masu*-form/*i*-adj/*na*-adj *soo desu*　V *te*-form *kimasu*

L.44

V *masu*-form/*i*-adj/*na*-adj *sugimasu*　V *masu*-form *yasui desu*　V *masu*-form *nikui desu*　*i*-adj *ku shimasu*　*na*-adj *ni simasu*　N *ni shimasu*

L.45

...*baai wa*, ...　...*noni*, ...

L.46

V dictionary form *tokoro desu*　V *ta*-form *tokoro desu*　V *ta*-form *tokoro desu*　V *ta*-form *bakari desu*　*...hazu desu*

L.47

plain form *soo desu*　*...yoo desu*

L.48

Causative verbs　V causative *te*-form *itadakemasenka*

L.49

Keigo 1　honorific verbs　*o* V *masu*-form *ni narimasu*　*o* V *masu*-form *kudasai*

L.50

Keigo 2　*o* V *masu*-form *shimasu*　*go* V *shimasu*　polite expressions　*gozaimasu*　*...de gozaimasu*　*yoroshii deshoo ka*

04. JAN 25 (Mon)　EXAMINATION

Japanese 3

Instructor: Associate Professor Wataru Nakamura and staffs

Offices: Nakamura: Rm 523, Institute for Excellence in Higher Education Building (Kawakita Joint Building)

Other staffs: Rm 106, International Exchange Building

Contact e-mail address: jlptohoku@gmail.com

Japanese 3 is for those who have completed Japanese 2 in the preceding semester or those who have equal proficiency (i.e., Level III according to the placement test for JAPANESE LANGUAGE PROGRAM AT KAWAUCHI). When you successfully complete this course, you can expect to pass Level 3 (N3) of the Japanese Language Proficiency Test (http://www.jlpt.jp/). Japanese 3 consists of the following four classes, and you must take all the four classes to receive the grade for the course:

[Oct 1 (Thr) Registration & Placement test]

G3a (Grammar):

Learn and practice post-beginning level grammatical patterns. The course materials are provided by the instructor.

S3a (Speaking):

Learn how to convey one's ideas and opinions orally in Japanese by having discussions and presentations on familiar and current topics in class. The course materials are provided by the instructor.

R3a (Reading):

Practice reading easy but authentic reading materials to familiarize yourself with written Japanese and boost up your reading comprehension ability. The textbook is "Daigaku/Daigakuin Ryuugakusei no Nihongo 1" published by ALC.

P3a (Practice):

Practice and utilize what you have learned in grammar, reading and speaking classes in actual communicative contexts.

Each class has its own class and exam schedule and grading policy, which are to be announced on the first day of the class. Japanese 3 grade will be based on the average score of the four classes.

Japanese 4

Instructor: Associate Professor Wataru Nakamura and staffs

Offices: Nakamura: Rm 523, Institute for Excellence in Higher Education Building (Kawakita Joint Building)

Other staffs: Rm 106, International Exchange Building

Contact e-mail address: jlptohoku@gmail.com

Japanese 4 is for those who have completed Japanese 3 in the preceding semester or those who have equal proficiency (i.e., Level IV according to the placement test for JAPANESE LANGUAGE PROGRAM AT KAWAUCHI). When you successfully complete this course, your proficiency will be between Level 2 (N2) and Level 1 (N1) of the Japanese Language Proficiency Test (http://www.jlpt.jp/). Japanese 4 consists of the following six classes, and you must take FOUR of them to receive the grade for the whole course:

[Oct 1 (Thr) Registration & Placement test]

G4a (Grammar):

Learn and practice upper-intermediate level grammatical patterns. The course materials are provided by the instructor.

S4a (Speaking):

Learn how to convey one's ideas and opinions orally in Japanese by having discussions and presentations on familiar and current topics in class. You are required to write a resume and short reports. The course materials are provided by the instructor.

R4a (Reading):

Practice reading easy but authentic reading materials to familiarize yourself with written Japanese and boost up your reading comprehension ability. The textbook is "Daigaku/Daigakuin Ryuugakusei no Nihongo 3: Ronbun Dokkai hen" published by ALC.

P4a (Practice):

Practice and utilize what you have learned in grammar, reading and speaking classes in actual communicative contexts.

SP4 (Short Program Planning):

In collaboration with Japanese students, we will be planning an educational tour for foreign students visiting Sendai during their short-term program (approximately two weeks). In the tour, foreign students will experience Sendai, the Tohoku region, and Japanese culture. We will research examples of short-term programs in various countries, and acquire a multicultural perspective that will allow both Japanese students and foreign students to assess the program from both the viewpoint of visitors and hosts.

JS4 (Japanese Songs):

In this class, students learn, and learn to sing most of, many Japanese traditional and popular songs together with Japanese students. By listening to and singing Japanese songs, and through communicating and discussing their interpretations, images and impressions of them with Japanese students, the international students will learn about the culture and points of view underlying them compared with those of their own.

Each class has its own class and exam schedule and grading policy, which are to be announced on the first day of the class. Japanese 4 grade will be based on the average score of the four classes you choose.

Japanese Culture A

Instructor : Koji Shidara
Contact e-mail : kojishidara@gmail.com

Place : C301-Building C Kawauchi Campus
Hour : 10:30-12:00 Wednesday

Course Objectives and Outline

Japanese Culture A is offered for foreign students to learn about and share insights into various aspects of the living culture of Japan. The course comprises three basic components: discussion of certain cultural aspects of the country; readings from Japanese literature; field trips to Sendai-area places of historical or cultural significance. These components are designed in such a way that they complement each other. Since the students come from all around the globe bringing widely varying cultural backgrounds with them, it is expected that the discussion in class may unfold in such a way that they learn not only about the Japanese culture but something about the sense of value of the other students as well with Japanese culture as the medium.

For field trips, students will be required to pay small fees to cover transportation and admission. Two of the field trips are day-long excursions on weekends using a chartered bus, whereas the rest of the trips happen during the regular class hour with destinations that are within walking distances from Kawauchi Campus. Field trip dates are subject to change due to various factors including weather conditions and scheduling conflicts.

Evaluation will be based on class participation, weekly homework assignments and the final paper.

Course Schedule

01. October 7	Course Orientation & "What's in a Name?"
02. October 14	Overview of the History of Tohoku
03. October 17 (Sat.)	Day-Long Field Trip to Nenoshiroishi and Mt. Izumigatake
04. October 21	Reading: "The Bears of Nametoko" by Miyazawa Kenji
05. October 28	The Story of Sendai Castle
06. November 4	Hiking the Sendai Castle Grounds
07. November 11	Reading: *Surviving the 2011 Tsunami*
08. November 18	Visiting the Sendai City Museum

09. November 25	The Story of Tamamushi Sadayu
10. December 2	Visiting the Miyagi Museum of Art
11. December 9	Reading: "The Flower-Eating Crone" by Enchi Fumiko
12. December 16	The Story of Shiroishi Castle
13. December 19 (Sat.)	Day-Long Field Trip to Shiroishi City
14. January 13	Student Presentation
15. January 20	Student Presentation—continued

Grade Assessment

AA : Excellent (90-100%)
A : Good (80-89%)
B : Fair (70-79%)
C : Passing (60-69%)
D : Failure (0-59%)

Textbook:

-Editorial Office of the Ishinomaki Kahoku, ed. *Surviving the 2011 Tsunami: 100 Testimonies of Ishinomaki Area Survivors of the Great East Japan Earthquake.* Tokyo: Junposha, 2014

Reference:

-Goossen, Theodore W., ed. *The Oxford Book of Japanese Short Stories.* Oxford: OUP, 2002

Detailed Course Description of Japanese Culture C

Ex-professor Yutaka FUJINO
on behalf of Professor Yoshitaka KASUKABE
Contact address: yu.fujino@jcom.home.ne.jp

In this course, students learn Japanese culture through practice of Aikido, a Japanese martial way (budo) developed by Morihei Ueshiba (often referred to as 'O-Sensei' or 'Great Teacher' by his title). Morihei Ueshiba developed Aikido, drawing on the rich history of the martial traditions of Japan and refining them into a wholly new system for the future. On the technical side, Aikido is, in this way, rooted in several styles of jujutsu, traditional Japanese martial arts, (in which modern Judo is also originated), in particular Daito-ryu-(aiki)-jujutsu, as well as sword and spear fighting arts.

A special lecture will be given by Aikido Doshu (Grandmaster), Moriteru Ueshiba, the Founder's grandson and Special Lecturer of Tohoku University.

Students are recommended to read the following reference books. The evaluation will be based on class participation and performance at the presentation.

Reference books:

Moriteru Uesiba "Progressive Aikido: The Essential Elements," Kodansha International, 2005.

John Stevens "Aikido: The Way of Harmony," Random House Inc., 1983.

Class Schedule for Japanese Culture C:

Oct. 7 Introduction by using a videodisc.

Contents are as follows:

Aikido bow (An expression of gratitude and respect)

Kamae (Stance)

Ma-ai (Conbative distance)

Shikko (Knee walking)

Kokyu-ryoku (Breath-power)

Basic techniques:

Irimi-issoku (One-step entering)

Kaiten (or Tenkan) (The act of turning around an attack)

Atemi (Strike) (The defensive blow used to neutralize the

ki of your partner, i.e., put him or her off balance so that a technique can be effectively applied. It is not meant to inflict injury.)
Katate-dori (Held by one hand)
Ryote-dori (Held by both hands)
Morote-dori (Held by two hands)
Shomen- uchi (Direct blow to the head)
Yokomen-uchi (Side blow to the head)
Tyoku-zuki (Punch)
Ukemi (The act of taking a controlled fall when thrown)
Zansin (Unbroken concentration, the follow through of a technique)

Oct. 14 through Jan. 20 except Nov. 25

The following basic skills are repeatedly practiced.

1. Ikkyo (Number one pinning technique)
   Omote and ura (forward and backward)
2. Nikyo (Number two pinning technique)
   Omote and ura
3. Sankyo (Number three pinning technique)
   Omote and ura
4. Yonkyo (Number four pinning technique)
   Omote and ura
5. Gokyo (Number five pinning technique)
   Omote and ura
6. Shiho-nage (Four-direction throw) (The first pillar of Aikido throwing technique)
7. Irimi-nage (Entering throw) (The second pillar of Aikido throwing technique)
8. Kaiten-nage (Turning throw) (The third pillar of Aikido throwing technique)
9. Kote-gasesi-nage (Wrist turn-out throw)
10. Tenchi-nage (Heaven and earth throw)
11. Kokyu-nage (Breadth-power throw)

Nov. 25 Special lecture is given by Aikido Doshu (Grandmaster), Moriteru Ueshiba, the Founder's grandson and Special Lecturer of Tohoku University.

Jan. 27 Presentation

*The lecture on Oct. 7 will be performed at the room 115 on the first floor in the building of the Global Learning Center on Kawauchi Campus from 1:00 p.m. The other lectures will be performed at a training room on the third floor in the Kawauchi gymnasium.

*A wear for Aikido, Judo or Karate is needed in practice (You can buy it for around 10,000 yen). The participants in this course can borrow an Aikido wear free. In order to borrow an Aikido wear, you will be required to sign your name on the prescribed form and to pay a laundry charge.

*Contents of the above-mentioned class schedule are subject to modification.

Course Title	**Mathematics A**
Semester	Fall
Credit	2
Instructor	**Assoc. Professor Koji HASEGAWA** **Assoc. Professor Yuu HARIYA** **Professor Tatsuya TATE**
E-mail	kojihas@math.tohoku.ac.jp hariya@math.tohoku.ac.jp tate@math.tohoku.ac.jp
Time and Day	Friday, 8:50-10:20 *First class: October 2nd
Place	Kawauchi campus B102

Course Objectives and Outline

Course Objectives

The aim of this course is to discuss various topics on modern mathematics.

Each lecturer gives 5 lectures of each topic. Students are assumed to be familiar with elementary multi-variable calculus and linear algebra. Courses grades are based on attendance, examination and report.

The textbook is not assigned in advance.

Course Outline

I. Matrix groups : an introduction (Hasegawa)

II. Basics of probability theory (Hariya)

III. Geometry on finite affine planes (Tate)

I. The notion of groups plays a considerable role in understanding symmetries in mathematics.

(1)(2) We will begin with some linear algebra and introduce the notion of matrix groups, consisting with matrices with certain properties.

(3) We will see that various examples of groups are in correspondence with various kind of geometries (Erlangen program).

(4)(5) Then we will know the notion of Lie algebras, which enables us to investigate the symmetryinfinitesimally. We will end with some recent related topics arise in mathematical physics.

II. (1) First we introduce the notion of probability spaces. A probability space is defined as a measure space with total measure 1. Each element in the associated sigma-field is called an event. Students are assumed to be fairly familiar with the fundamentals of measure theory (the theory of Lebesgue integrals).

(2) We introduce the notion of random variables (r.v.'s). An r.v. is a measurable function defined on the probability space. Several examples of r.v.'s are given.

(3)(4) Associated with the notion of r.v.'s, two important quantities, the expected value and variance, are introduced. Some concrete computations of them are shown.

(5) We introduce the notion of independence, which is very important in probability theory. We start with the independence of events, and then extend it to that of r.v.'s. These three notions, expected value, variance and independence, play an essential role in formulating limit theorems in probability theory, some of which will be introduced in Mathematics B.

III. This part of the series of lectures concerns geometry for "magic squares". A square grid of size n (not less than three) with distinct numbers in each square is called a magic square if the sum of n numbers on each column or each row is the same number. There are other types of magic squares, but this class of magic squares is closely related the geometry on "finite affine planes".

The goal is to give how to construct magic squares of arbitrary size (other than six), by using the finite affine geometry, and give an explanation why the magic squares of size six can not be constructed by the method given here.

(1) At the beginning, the definition, examples and some simple properties of the magic squares we are going to consider here will be given.

(2) The axiomatic treatment of the finite affine geometry will be explained.

(3), (4) By introducing the notion of finite fields, examples of finite affine planes will be given.

(5) A method to construct magic squares by using finite affine geometry will be explained.

Assessment Criteria

Courses grades are based on attendance, examination and report.

Textbook

None, print+handout

Oct. 2	Hasegawa	1. Review in linear algebra
Oct. 9	Hasegawa	2. Matrix groups
Oct. 16	Hasegawa	3. Various examples
Oct. 23	Hasegawa	4. Introduction to Lie theory
Nov. 6	Hasegawa	5. Some recent topics
Nov. 13	Hariya	6. Probability spaces
Nov. 20	Hariya	7. Random variables
Nov. 27	Hariya	8. Expectation and variance
Dec. 4	Hariya	9. Examples
Dec. 11	Hariya	10. Independence
Dec. 18	Tate	11. Magic squares, Latin squares and Euler squares
Dec. 25	Tate	12. Axiomatic treatment of finite affine geometry
Jan. 8	Tate	13. Finite fields and finite affine planes
Jan. 22	Tate	14. Examples of finite affine planes
Jan. 29	Tate	15. Construction of magic squares

Course Title	**Introductory Courses of Experimental Research in Physics III**
Semester	Fall
Credit	2
Instructor	Masayuki Yoshizawa, Professor, Department of Physics, Graduate School of Science
E-mail	m-yoshizawa@m.tohoku.ac.jp
Time and Day	Monday and Tuesday, 13:00-16:10
Place	Aobayama Campus
Entry to the Course	Students are requested to contact Prof. M. Yoshizawa by Email (m-yoshizawa@m.tohoku.ac.jp) for entry to the course by **Oct. 7.** Assignment of subjets is done by office considering request and capacity.

Course Objectives and Outline

Experiments are very important for development of new physics. Based on basic knowledge of physics, students experience introductory experiments of leading researches.

Learning Goal

The goal of this program is to let students experience basic research of experimental physics.

Course Content

Students are required to perform two subjects from the flowing list.

(1) The first subject (November 16 - December 15)
- (1-a) Experimental Nuclear Physics
- (1-b) Intermediate Energy Nuclear Physics
- (1-c) Nano Solid-State Physics
- (1-d) Solid-State Quantum Transport

(2) The second subject (December 21 - January 26)
- (2-a) Experimental Particle Physics (Research Center for Neutrino Science)
- (2-b) Photoemission Solid-State Physics
- (2-c) Softmatter Biophysics

Course Schedule
1) Entry and assignment of subjects Students are requested to contact Prof. M. Yoshizawa by Email (m-yoshizawa@m.tohoku.ac.jp) for entry to the course by Oct. 7. Assignment of subjets is done by office considering request and capacity. 2) November 160 — December 15 The first subject. 3) December 21 – January 26 The second subject.
Assessment Criteria
Grades of the course will be assigned as follows: AA.....Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D.....Failure (0-59%) Students will be evaluated based on: class attendance, presentations, and reports.
Textbook
Note

Physical Chemistry

Professors Naoki Kishimoto, Hirohiko Kono, Akihiro Morita, Hiroshi Fukumura
Contact address morita@m.tohoku.ac.jp

Place: R105 International Exchange Building
Hour: 8:50-10:20 Wednesday except Nov.4 -18.
*** The lectures on Nov. 4 - 18 are given at 14:40 - 16:10 Wednesday ***

Modern physical chemistry is the basis of applied science and engineering. Reaction kinetics is useful in a variety of chemical reactions occurring in our environment. Spectroscopy is an essential tool in life science and material science. In order to understand chemical reaction and spectroscopy, one has to learn the fundamentals of quantum chemistry and statistical thermodynamics. In this course, these two essential subjects will be given by four different lectures who are experts of modern physical chemistry.

Students will be evaluated by each lecturer with attendance, short tests, or reports depending on the lecturer, which will be explained during the lectures.

Course Outline

01-04 October 7, 14, 21, 28 (Prof. Naoki Kishimoto)

Mechanisms of chemical reactions and more are lectured over 3 (or 4) times. Important topics are as follows; ozone hole problem (destruction of an ozone layer), temperature dependence of reaction rates, kinetic theory of gases, theories of chemical reactions, and molecular reaction dynamics. Handout will be distributed.

05-07 November 4, 11, 18 (Prof. Hirohiko Kono)

These three lectures cover the basics of quantum chemistry: quantum theory, atomic orbitals, many-electron atoms, molecular orbitals. The structures and reactivities of molecules are discussed on the basis of quantum chemistry. Animations on chemical reactions such as strand breaks of DNA are presented to understand the fundamental concepts of chemical reactions.

08-10 November 25, December 2, 9 (Prof. Akihiro Morita)

These lectures deal with computational chemistry, an emerging field in chemistry and materials science. Thanks to the amazing progress of computers, recent computational chemistry allows us to analyze detailed molecular properties and chemical reaction mechanisms. We think that solid understanding of the basic concepts of computational chemistry is essential for us to properly utilize various methods of computational chemistry. The present lectures include the history of computer simulation, the basic concepts of quantum chemistry and molecular simulation, and current application to science and industries.

11-13 January 13, 20, 27 (Prof. Hiroshi Fukumura)

Current topics in physical chemistry, particularly in relation to the research activities in the lecturer's laboratory, are discussed. These topics include

1) fluorescence and optical microscopy;
2) phase change dynamics of liquid mixtures;
3) fundamentals of laser material processing.

Textbook:

Any textbook with the title including "physical chemistry" will be fine. Each of the lecturers may have one's favorite textbooks and study-aid books. These will be announced at the beginning of each topic.

Detailed Course Description

Dynamics of the Earth

Assoc.Prof. Motohiko MURAKAMI
Contact address: motohiko@m.tohoku.ac.jp
Assist.Prof. Takahiro KURIBAYASHI
t-kkuri@m.tohoku.ac.jp
Assist.Prof. Tatsuya SAKAMAKI
sakamaki@m.tohoku.ac.jp
Assist.Prof. Yoshihiro Furukawa
yoshihiro@m.tohoku.ac.jp
Assist.Prof. Akio GOTO
ak-goto@cneas.tohoku.ac.jp

PLACE: International Exchange Building, R115
(Some classes will be given at Geology building@Aoba-yama campus)
TIME: 10:30-12:00 (10:45-12:00 when held at Aoba-yama campus), Tuesday

This is an introductory geology program to understand the Earth dynamics. The constituents of the Earth (minerals and rocks, and their geochemical roles) and basic mineralogy, petrology, volcanology and experimental mineral physics will be taught, and the structure of the Earth and driving forces for the Earth dynamics (volcanic activities, earthquake, hot spring, etc) will be discussed. A short field trip around Tohoku Univ., a university museum tour, and an ultra high-pressure laboratory tour are planned.
Discussions during the classes will be encouraged.
Attendance, discussion in the classes, and a brief examination will be considered for the evaluation.

Schedule

01 Oct.6	Introduction to Earth's history (Furukawa) (Formation of planetary system, ocean, and continents)
02 Oct.13	No class
03 Oct.20	No class
04 Oct. 27	Co-evolution of Life and Earth (Furukawa) (Photosynthesis and the rise of Earth's oxygen level, birth of aerobe, mass extinction, global warming)
05 Nov.3	No Class
06 Nov.10	Introduction to volcanology (Goto)
07 Nov.17	Physics of magma transport (Goto)
08 Nov.24	Viscosity of magma and its influences on volcanic activity (Goto)
09 Dec.1	Origin of life and astrobiology (Furukawa)
10 Dec.8	Earth's Deep Structure (Sakamaki)
11 Dec.15	Water circulation in the interior of the Earth (Sakamaki)
12 Dec. 22	High-pressure and -temperature phase transformations (Sakamaki)
13 Jan.5	Introduction to Mineralogy and Crystallography (Kuribayashi)
14 Jan.12	Classification of Minerals (Kuribayashi)
15 Jan.19	University Museum Tour (Kuribayashi)

Ecology and evolution

Contact address; kawata@m.tohoku.ac.jp (Prof. Kawata)
Place; Room 115 at International Exchange Building.
Time; 8:50 — 10:20 every Tuesday

This course aims to give students some basic concepts on vegetation, ecology and evolution using materials lecturers have been studying. Students are required to attend the class and to submit an essay dealing with a topic covered in one of the lectures. Do not skip class without notifying the lecturer by e-mail in advance.

October 6, 13, 20
Introductory to Evolution (M. Kawata)
The evolution is a change over time in the proportions of individual organisms differing genetically in one or more traits. Evolution is the most important factor creating biological diversity. The purpose of this lecture is to explain basic mechanisms for evolution within populations and evolution of creating species (speciation) .
(1) Evolution: Natural selection (10/6)
(2) Evolution:Genetic drift and natural selection (10/13)
(3) Evolution: Speciation (10/20)

October 27, November 10,
Gene and genome duplication (T. Makino)
I give a lecture focusing on animal evolution driven by gene and genome duplication.
(1) Evolution by gene duplication(10/27)
Gene duplication frequently occurs in eukaryotic genomes and plays a major role in evolution.
(2) Vertebrate evolution after whole genome duplication
Whole genome duplication has made a significant contribution to vertebrate evolution. (11/10)

November 24
TBA

November 17, December 1
Speciation in plants (M. Maki)
(1) Reproductive isolation in plants.
Many various mechanisms of reproductive isolation are developed in plants. In this lecture, I will outline them. (11/17)
(2) Speciation in plants
In plants, two major mechanisms of speciation has been known; one is allopatric speciation and the other is allopolyploidal speciation. In this lecture, I will outline these two speciation mechanisms in plants. (12/1)

December8, 15,
Adaptive strategies of plant reproduction (S. Sakai)
I lecture adaptive strategies of plant reproduction. Using mathematics, I explain the optimal strategies and evolutionarily stable strategies.
(1) Game theory (12/8)
(2) Ecology of flowers (12/15)

December 22, January 5, 12

Community Ecology (S. Chiba)

The preservation of species diversity on earth has emerged as one of the most important environmental issues of our time. The purposes of this lecture is to understand why many species can coexist in an ecosystem and how species diversity is maintained. We will discuss how we can conserve species diversity, give some examples in relation to this topic.

(1) Mechanisms of species coexistence (12/22)
(2) Patterns of species diversity in time and space (1/5)
(3) Species extinction and conservation of species diversity (1/12)

January 19, 26

Functional ecology in plant response to environmental change (R. Oguchi)

Plants experience various environments in their life in time and space. Ecological and physiological viewpoint of plant response to the environmental change, especially about the mechanisms and its restriction of adaptation and acclimation to the changing environment will be lectured.

(1) Plant response to change in light environment (1/19)

(2) Plant response to change in atmospheric CO_2-concentration and temperature (1/26)

Nuclear Physics

Professor Satoshi N Nakamura (Department of Physics)
Contact address nue@lambda.phys.tohoku.ac.jp
Place: Aobayama Campus Sci.Complex B[H-03] 743
Hour: 13:00-14:30 Thu
First day of class: Thursday, October 1, 2015

Modern nuclear physics is study of many-body system interacting by the strong interaction. Based on a picture which treats a nucleus as multi-quark system or hadronic system, basic introduction to the modern nuclear physics will be given. Based on the recent experimental techniques and results, it will be discussed how we understand behavior of materials under extreme conditions like early universe or deep inside of neutron stars.

The goal of this lecture is to learn basic concept of modern nuclear physics and recent research techniques.

Evaluation will be based on class participation, quiz during each lecture and the essay.

Course Outline

01. What is nuclear physics? Definition of nuclear physics in this course and basic terminologies necessary for nuclear physics study will be explained.

02. Mass of nucleus and binding energy of nucleon will be discussed.

03. Lifetime of radio isotopes, radiation and radiation effects to health will be explained. Course participants will discuss about the Fukushima accidents.

04. Iso-spin and charge symmetry of nuclear force will be discussed.

05. Electron scattering experiments and exotic atoms will be discussed.

06. Rosenbluth formula and experiments to measure form factors will be discussed. Relation between the results of those experiment and charge distribution of nucleus will be discussed.

07. Quasi-elastic scattering and nuclear resonances will be discussed.

08. Deep inelastic scattering and structure function will be discussed.

09. Quark model and Baryons will be explained.

10. Baryon magnetic moment and color in QCD will be explained.

11. Nuclear force, Fermi gas model and neutron stars will be discussed..

12. Shell model and hypernuclei will be discussed.

Textbook

No textbook will be used. Resumes with necessary information will be given in the course.

If you want to study modern nuclear physics more, following reference books are recommended.

Bogdan Povh et al. , "Particle and Nuclei", Springer.

C.A.Bertulani, "Nuclear Physics in a Nutshell", Princeton U. Press

W.R.Leo, "Techniques for Nuclear and Particle Physics Experiments", Springer

Solid State Physics and Statistical Physics

Associate Professor Naokazu Shibata
Contact address shibata@cmpt.phys.tohoku.ac.jp

Place: Science Complex B [H-03] 745
Hour: 13:00-14:30 Tuesday

This course explains elementary treatment of fundamental theoretical concepts of solid state materials. Fermi liquid theory, magnetism, superconductivity lie at the heart of solid state physics. We understand these phenomena based on statistical mechanics and quantum theory.

Evaluation will be based on submitted reports and examinations.

Course Outline

1	October 6	Introduction to solid state
2	October 13	Ground state and thermal properties of electron gas
3	October 20	Crystal lattice and Brillouin Zone
4	October 27	Electrons in a periodic potential and band structure
5	November 10	Motion of atoms in solid
6	November 17	Quantum lattice vibrations and phonons
7	November 24	Fermi liquid theory
8	December 1	Failures of band theory and Mott insulator
9	December 8	Hubbard model
10	December 15	Magnetism
11	December 22	Superconductivity
12	January 5	Electron-phonon interaction and Pairing mechanism
13	January 12	BCS theory
14	January 19	Examination or supplementary lecture
15	January 26	Examination or supplementary lecture

Textbook: Ashcroft, Mermin "*Solid State Physics*" Thomson Learning (1976)

Material Science

Associate Professor　Takafumi Sato　(Department of Physics)
Contact address　t-sato@arpes.phys.tohoku.ac.jp
Place:　Aobayama Campus　Sci.Complex B[H-03] 745
Hour:　10:30-12:00　Thu
First day of class:　Thursday, October 8, 2015

In this course, students will lean fundamental concepts of solid state physics, such as crystal structure, reciprocal space, x-ray diffraction, phonon, band dispersion, Fermi surface, magnetism, semiconductor, and superconductivity.

Evaluation will be based on class participation, homework assignment, and the final examination.

Course Outline

01: Course orientation
An overview of the lecture which includes brief introduction of solid-state physics.

02: Category of solids: Structure and chemical bonding
Concepts of Bravais lattice, reciprocal lattice, and Brillouin zone will be discussed.

03: General introduction of diffraction
Bragg's law, x-ray diffraction, and neutron diffraction experiments will be discussed.

04: Phonons
Basic concept of phonons, heat capacity, heat conduction, and Debye/Einstein model will be discussed.

05: Free electrons I
Basic concepts related to free electrons such as density of states, specific heat, and electrical conductivity will be discussed.

06: Free electrons II
Optical response of nearly free electrons, Hall conductivity, Pauli paramagnetism, and Landau diamagnetism will be discussed.

07: Periodic potential

Bloch theorem, band structure, energy gap, band calculations, and tight-binding approximation will be discussed.

08: Fermi surface

Basic concepts of Fermi surface such as Luttinger theorem and Landau level will be discussed.

09: Experiments to determine Fermi surface

Experiments such as photoemission spectroscopy, de Has van Alphen effect, and tunneling spectroscopy will be discussed.

10: Physical properties related to Fermi surface

Fermi-surface-related physical properties such as charge density wave and spin density wave will be discussed.

11: Semiconductor I

Important concept of semiconductors such as band gap, chemical potential, and impurity level will be discussed.

12: Semiconductor II

Basics of semiconductors such as diode, transistor, and p-n junction will be discussed.

13: Superconductivity

Basic concepts of superconductors such as Cooper pairing, BCS theory, and perfect diamagnetism will be discussed.

14: Recent topics in solid state physics I

Recent topics in condensed-matter physics such as high-T_c superconductivity, graphene, and topological insulators will be discussed.

15: Semester final examination

Textbook:

Standard textbooks of solid-state physics (*e.g.*, "Solid-State Physics, An Introduction to Principles of Materials Science", Harald Ibach, Hans Luth).

Course Title	**Agricultural Science**
Semester	Autumn
Credit	2
Instructor	(Contact: Prof. Fusao ITO) 1. Prof. Masanori SAITO, 2. Prof. Masami NANZYO, 3. Prof. Kenji SEIWA, 4. Associate Prof. Tomokazu FUKUDA, 5. Associate Prof. Sng-gun ROH, 6. Associate Prof. Chika TADA, 7. Prof. Yukio AGATSUMA, 8. Prof. Satoshi KATAYAMA, 9. Associate Prof. Toshiyasu YAMAGUCHI, 10. Prof. Kiyohide MORITA, 11. Prof. Shinobu KITANI, 12. Associate Prof. Chinatsu YONEZAWA,
E-mail	(Contact: fusao@bios.tohoku.ac.jp) 1. msaito@bios.tohoku.ac.jp 2. nanzyo@bios.tohoku.ac.jp 3. seiwa@bios.tohoku.ac.jp 4. tomofukuda@bios.tohoku.ac.jp 5. sanggun_roh@bios.tohoku.ac.jp 6. tada@bios.tohoku.ac.jp 7. agatsuma@bios.tohoku.ac.jp 8. skata@bios.tohoku.ac.jp 9. ymg@bios.tohoku.ac.jp 10. kimorita@m.tohoku.ac.jp 11. skitani@m.tohoku.ac.jp 12. chinatsu@bios.tohoku.ac.jp
Time and Day	8:50-10:20, Every Tuesday between October 6, 2015 and January 5, 2016 (Except National Holida and New Year Holidays)
Place	Seminar Room 2 in Amamiya Campus

Course Objectives and Outline

A series of lectures covers a wide range of topics on agricultural science: plant production science, animal production science, applied aquatic bioscience, resource and environmental economics, and field science. The course objective is to educate students to learn sustainable food production systems harmonious with environment.

Learning Goal

Students will come to understand basic agricultural sciences.

Course Content		
Oct. 6	Prof. M. SAITO	Effect of Fukushima Daiichi Nuclear Power Station Accident on Agricultural Environment
Oct. 13	Prof. M. NANZYO	Fundamentals of soils in Japan - As exemplified by volcanic ash soils * Lecture Room 5
Oct. 20	Prof. K. SEIWA	Mechanisms and Functioning of Species Diversity in Forest Ecosystems
Oct. 27	Assoc. Prof. T. FUKUDA	Basics of the Molecular Genetics for Animal Science
Nov. 10	Assoc. Prof. S.ROH	Principles of Ruminant Physiology
Nov. 17	Assoc. Prof. C. TADA	Construction of the Circulating Society by Using Biomass Resource to Save and Make Energy
Nov. 24	Prof. Y. AGATSUMA	Trophic Interactions in Kelp Forest Ecosystems
Dec. 1	Prof. S. KATAYAMA	Fluctuations in Coastal Fisheries Resources around Japan
Dec. 8	Assoc. Prof. T. YAMAGUCHI	Nutritional Benefits of Marine Products beyond the Risk
Dec. 15	Prof. K. MORITA	Agricultural Policy in Japan
Dec. 22	Prof. S. KITANI	What is Environmental Risk ?
Jan. 5	Assoc. Prof. C. YONEZAWA	Application of Geographic Information in Japan

Assessment Criteria
Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D.....Failure (0-59%)
Course evaluation will be based on the attendance to the lectures including active participation, contribution to discussion. Students are expected to join discussion in each lecture.

Textbook
None
Note
High attendance is required.

Subject	Introduction to Fisheries Science (水産科学概論)	Time and Day	Friday, 10:30-12:00 *First class: October 2nd	Object	AMB, JYPE
Instructors	Y. Agatsuma, M. Aoki, M. Osada, K. Takahashi, S. Katayama, K. Sasaki, Y. Ochiai, T. Yamaguchi, Y. Endo, W. Sato-Okoshi, T. Suzuki, M. Nakajima, Y. Sakai, A. Kijima, M. Ikeda	Categories	Specialized Subjects	Credits	2
				Semester	4
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Place	Seminar Room 1 (Lecture Room Build.) Agricultural Science, Amamiya Campus

1. Class subject
Introduction to Fisheries Science

2. Object and summary of class
This course provides an overview of the fishery science. Students will learn the fishery science on the basis of marine biology in a broad sense from molecules to ecosystems.

3. Goal of study
The goal is to understand the fishery science basically from ecology, physiology, genetics, molecular biology and evolution, and to appreciate the fishery science as the applied marine biology.

4. Contents and progress schedule of class

Topics on marine ecology and oceanography

Lab Fisheries Biology & Ecology

Oct. 2 ------ "How to know the fish age" (S. Katayama)
Oct. 16 ---- "How to know the fish migration" (S. Katayama)

Lab Marine Plant Ecology

Oct. 9 ------ "The ecology of floating seaweeds" (M. Aoki)
Oct. 23 ---- "Introduction to rocky subtidal communities" (Y. Agatsuma)

Lab Biological Oceanography

Nov. 6 ------ "Physical and chemical environment of marine organisms" (Y. Endo)
Nov. 13 ---- "Plankton and benthos in the ocean" (W. Sato-Okoshi)

Topics on biology and biochemistry of aquatic organisms

Lab Aquacultural Biology (M. Osada, K. Takahashi,)

Nov. 20 ---- "Manipulation of reproduction in bivalve mollusks" (M. Osada)
Nov. 27 ---- "Immunity in marine invertebrates" (K. Takahashi)

Lab Marine Biochemistry

Dec. 4 ------ "Food chemistry of fish and shellfish" (Y. Ochiai)
Dec. 11 ----- "Function of marine lipids" (T. Yamaguchi)

Topics on fish genetics and biotechnology

Lab Marine Life Science & Genetics

Dec. 18 ----- "Fish development and biotechnology" (T. Suzuki)
Dec. 25 ----- "Genetic conservation and sustainable use of resources in aquatic organisms" (M. Nakajima)

Lab Integrative Aquatic Biology

Jan. 8 ------ "Conservation genetics for fishery resources -1" (M. Ikeda)
Jan. 15 ---- "Conservation genetics for fishery resources -2" (A. Kijima)

5. Record and evaluation method

Attendance and report. The report should be directly submitted to the instructor of each lecture by the next lecture.

6. Textbook and references

No textbook. Reference books will be introduced.

7. In addition

Questions, comments, and requests accepted.

Send them to the representative instructor, Professor Suzuki: suzukitr@bios.tohoku.ac.jp

Subject	Aquatic Plant Ecology (水圏植物生態学)	Day/Period	Tues./2nd *First class: October 6th	Object	AMB, JYPE
Instructor	Y. Agatsuma	Categories	Specialized Subjects	Credits	2
				Semester	6
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Place	Seminar Room 1 (Lecture Room Build.) Agricultural Science, Amamiya Campus

1. Class subject
Interaction between herbivores and marine plants in coastal rocky bottoms

2. Object and summary of class
This course provides reproduction, grazing activity, population dynamics of herbivores associated with marine forest. Students will learn marine forestation, and management and enhancement means of sea urchin and abalone associated with their ecological characteristics.

3. Goal of study
The goal is to understand how sea urchin and abalone maintain their population associated with seaweeds beds and how enhancement means of seaweed, sea urchin and abalone were developed on the basis of biological and ecological knowledge.

4. Contents and progress schedule of class

1. Structure and function of marine forest
2. Reproduction of herbivore
3. Growth and gonad production of herbivore
4. Grazing activity
5. Chemical defense of seaweeds
6. Mechanisms of population maintenance and fluctuation
7. Effects of sea urchin grazing on rocky subtidal communities
8. Restoration of "barren"
9. Effect of ocean warming and acidification on rocky subtidal communities
10. Development of enhancement means of sea urchin and abalone

5. Record and evaluation method
Examination, report and attendance

6. Textbook and references
Reference texts:
Lawrence JM (2013) Sea urchins: biology and ecology. Elsevier.

7. In addition
Questions, comments, and requests are accepted. Send them to Professor Agatsuma: agatsuma@bios.tohoku.ac.jp
Office hour: Tuesday 16:00~18:00 in Professor room of Laboratory of Marine Plant Ecology

Course Title	**Mechanics of Materials**
Semester	Autum-Winter
Credit	2
Instructor	Professor Hideo Miura, Assoc. Professor Kazuhisa Sato., Assoc. Professor Kanjuro Makihara
E-mail	hmiura@rift.mech.tohoku.ac.jp, kazuhisa@rift.mech.tohoku.ac.jp, makihara@ssl.mech.tohoku.ac.jp
Time and Day	Wendsdey, 8:50-10:20 (This course will start on Oct. 7, 2015.)
Place	Lecture Room-R115 International Exchange Building

Course Objectives and Outline

Mechanics of materials is a branch of applied mechanics that deals with the basic behavior of solid bodies subjected to various types of loading. The knowledge of the stress and strain set up within the bodies and resulting deflection is a prerequisite for the structural design of industrial products and infrastructures such as buildings, roads, and bridges.

This course is intended as an introductory course in the mechanics of solids offered to engineering students. It concentrates on developing analysis techniques from principle for a range of practical problems that include simple structures, pressure vessels, beams and shafts. This course is one semester course.

Learning Goal

Students will come to understand how to evaluate two-dimensinal stress and strain fields in a solid structure quantitatively.

Course Content

The topics covered in this course are Hooke's law, and stress-strain diagram, strength and stiffness, tension, compression and shear, combined stresses, torsion, shearing force and bending moment in a beam, stress and deflection of a beam, and statically indeterminate beam.

Oct. 7	Prof. Miura	Introduction (1): Modeling of engineering systems and concepts of stress and strain
Oct. 14	Prof. Miura	Introduction (2): Hooke's law, and stress-strain diagram, strength and stiffness
Oct. 21	Prof. Miura	Tension, compression and shear (1): Pin-jointed structures and statically indeterminate problems
Oct. 28	Prof. Miura	Tension, compression and shear (2): Thermal stress and residual stresses, thin rings, and stress concentration
Nov. 4	Prof. Miura	Mid-term examination (1)
Nov. 11	Assoc. Prof. Sato	Combined stresses (1): Biaxial tension, normal stress and shear stress, plane stress
Nov. 18	Assoc. Prof. Sato	Combined stress (2): Stress-strain relations
Nov. 25	Assoc. Prof. Sato	Torsion (1): Torsion of circular shafts, and close-coiled helical spring
Dec. 2	Assoc. Prof. Sato	Torsion (2): Shaft of rectangular or profile section and thin-walled tube of arbitrary cross section
Dec. 9	Assoc. Prof. Sato	Mid-term examination (2)
Dec. 16	Assoc. Prof. Makihara	Shearing force and bending moment in a beam: Type of supports for beams and reactions, type of loads on a beam
Jan. 6	Assoc. Prof. Makihara	Stress in a beam
Jan. 13	Assoc. Prof. Makihara	Deflection of a beam
Jan. 20	Assoc. Prof. Makihara	Statically indeterminate beam
Jan. 27	Assoc. Prof. Makihara	Final examination

Assessment Criteria
Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D.....Failure (0-59%)
The student's performance will be evaluated by considering the results of homework and examinations.

Textbook
1) S. Timoshenko and D. H. Young, "Elements of Strength of Materials," Van Nostrand Reinhold Company (1968). 2) W., Nash and M., Potter, "Strength of Materials, 5th Edition", McGrawhill, (2011).
Note
After the presentation of the underlying theory for each topic, the students will be provided with problems for homework to aid the understanding of the principles. It is assumed that the students have some experience in elementary statics (mechanics of rigid bodies) and mathematics (such as differentiation and integration).

Materials Science and Engineering A

Prof. Yutaka WATANABE

Contact address yutaka.watanabe@qse.tohoku.ac.jp.

PLACE: Aobayama Campus
(Lecture House of the Department of Mechanical and Aerospace Engineering, Room 3 (Ki-3))

TIME: 10:30-12:00, Friday

This course will provide concise introduction to the microstructures and processing of materials and how these are related to the properties of engineering materials. In this course, although we mostly deal with metals, properties of other engineering materials will also be discussed.

The goal of this course is understanding basic properties of materials, of how properties are related to microstructures, of how microstructures are controlled by processing, and of how materials are formed and joined.

Evaluation will be based on "class participation and homework assignment (30%)" and "final exam (70%)".

1. **Orientation** October 2 (Friday)

2. **Properties and Structures of Metals** October 9 (Friday)

   ・Generic metals and alloys

   ・Design data

3. **Properties and Structures of Metals** October 16 (Friday)

   ・Range of metal structures that can be altered to get different properties

4. **Equilibrium Constitution and Phase Diagrams** October 23 (Friday)

   ・Mixing elements to make an alloy can change their structure

5. **Case Studies in Phase Diagrams** October 30 (Friday)

   ・Phase diagrams

6. **Case Studies in Phase Diagrams** November 6 (Friday)

   ・Examples; choosing soft solders, pure silicon for microchips, making bubble-free ice

7. **Driving Force for Structural Change** November 13 (Friday)

- Solidification, solid-state phase changes, precipitate coarsening, grain growth, recrystallisation

8. **Kinetics of Structural Change** November 20 (Friday)

- Diffusive transformations

9. **Kinetics of Structural Change** November 27 (Friday)

- Nucleation
- Displacive transformations

10. **Case Studies in Phase Transformation** December 4 (Friday)

- Artificial rain-making
- Fine-grained castings

11. **Case Studies in Phase Transformation** December 11 (Friday)

- single crystals for semiconductors
- Amorphous metals

12. **Carbon Steels** December 18 (Friday)

- Structures produced by diffusive changes
- Structures produced by displacive changes (martensite)
- TTT diagram

13. **Alloy Steels** January 8 (Friday)

- Solution strengthening
- Precipitation strengthening
- Corrosion resistance

14. **Production, Forming, and Joining** January 15 (Friday)

- Casting
- Plastic working
- Joining
- Surface engineering

15. **Final exam** January 22 (Friday)

Textbook:

Engineering Materials 2, M.F. Ashby and D.R.H. Jones, ELSEVIER

Mechanical Vibration I

Associate Professor Hisashi Nakamura,
Department of Mechanical Systems and Design
Innovative Energy Research Center, Institute of Fluid Science
http://www.ifs.tohoku.ac.jp/enerdyn/index.htm
Contact address: nakamura@edyn.ifs.tohoku.ac.jp

Place: Room 3, Lecture Room Building-Mechanical Engineering
Hour: 14:40-16:10, Thursday

With the increase of velocity and the decrease of weight in modern machines, the analysis of vibration problems is becoming more and more important in engineering design. Therefore, in this course, the focus will be on the acquisition of fundamental knowledge regarding dynamic problems which may arise in machinery. To develop their understanding, students will be asked to solve examples during the lectures and as homework. I will also ask some students to show us their solutions during the following lectures. Evaluation will be based on attendance, homework and a final examination.

Course Outlines

01 October 1 (Thu), 2015

Introduction

Mathematical fundamentals

02 October 8 (Thu)

Free vibrations of systems with one degree of freedom (I)

The simplest possible vibratory system consists of a mass element connected by a spring. It is called a system with one degree of freedom since one coordinate is sufficient to specify the position of the mass. There is no external force applied to the mass. Hence, the motion resulting from an initial disturbance is a free vibration. We will firstly focus on such systems, which are fundamental to the understanding of more advanced topics concerning vibrations.

03 October 15 (Thu)

Free vibrations of systems with one degree of freedom (II)

04 October 22 (Thu)

Free vibrations of systems with one degree of freedom (III)

05 October 29 (Thu)

Forced vibrations of systems with one degree of freedom

If a system is subjected to an external force, the resulting vibration is known as forced vibration. We shall consider the dynamic responses of systems with one degree of freedom under harmonic force.

06 November 5 (Thu)

Free and forced vibrations of systems with one degree of freedom with viscous damping(I)

In actual practice, the amplitude of free vibration diminishes gradually over time due to the resistance offered by the surrounding medium (such as air). Such vibrations are said to be damped. We shall consider damped vibrations in the absence of forces and under harmonic forces. We shall consider damped vibrations in the absence of forces and the vibrations under harmonic forces.

07 November 12 (Thu)

Midterm examination

08 November 19 (Thu)

Free and forced vibrations of systems with one degree of freedom with viscous damping(II)

09 November 26 (Thu)

Free and forced vibrations of systems with one degree of freedom with viscous damping(III)

10 December 3 (Thu)

Free and forced vibrations of systems with one degree of freedom with viscous damping(IV)

11 December 10 (Thu)

Free and forced vibrations of systems with two degrees of freedom (I)

We sometimes encounter systems which consist of several masses connected by several springs. In this case, multiple independent coordinates are required to describe the motion of the masses. Such systems are said to have multiple degrees of freedom. We will learn about systems with two degrees of freedom so as to provide a simple introduction to the behavior of systems with multiple degrees of freedom. The dynamic responses of systems with two degrees of freedom under harmonic force will also be introduced.

12 December 17 (Thu)

Free and forced vibrations of systems with two degrees of freedom (II)

13 December 24 (Thu)

Free and forced vibrations of systems with two degrees of freedom (III)

14 January 7 (Thu)

Vibrations of systems with multiple degrees of freedom (I)

All the concepts introduced in the preceding lectures can be directly extended to the case of systems with multiple degrees of freedom. The general analysis of such systems can be handled conveniently in matrix form. We shall therefore consider how to analyze such complex systems using matrix form. It is often convenient to analyze such systems by using Lagrange's equations. We will therefore also learn how to analyze such systems using Lagrange's equations.

15 January 14 (Thu)

Final examination

Textbook:

Textbook to be used will be announced later.

Reference books:

S. S. Rao, *"Mechanical Vibrations SI (5th Edition)"* Pearson Education, 2011.

S. G. Kelly, "*Mechanical Vibrations*", Schaum's Outline Series, 1996.

R. F. Steidel, Jr., "*An Introduction to Mechanical Vibrations, (3rd Edition)*" Wiley, 1989.

M. Katatoka and T. Ioi, "*Fundamentals of Mechanical Vibration*" 「振動工学の基礎」, Corona Publishing Co. 1993. (in Japanese)

K. Aso, J.Tani, S. Chonan and K. Hayashi, "*Kikai Rikigaku*" 「機械力学」, Asakura Publishing Co., 1986. (in Japanese)

Course Title	**Electricity and Magnetism A**
Semester	Autumn
Credit	2
Instructor	**Professor Taiichi Otsuji,** **Professor Takumi Fujiwara**
E-mail	otsuji@riec.tohoku.ac.jp Fujiwara@laser.apph.tohoku.ac.jp
Time and Day	Wednesday, 8:50-10:20, from Oct. 7.
Place	Lecture Room 2-413 (2F Seminar RM, EE_BLDG#2) Department of Electrical Engineering, Communications Engineering, Electronic Engineering, and Applied Physics, Aobayama Campus.

Course Objectives and Outline

Electricity and Magnetism (EM) is a branch of physics and one of the fundamental and key studies in the engineering. Do you know what kind of phenomena or applications are related to the electricity and magnetism? Coulomb's law, Faraday's law, and electromagnetic induction are well known in the world of physics. For applications and / or device fabrications related to the electrons and magnetism, you must study following subjects in near future; such as microwaves, antennas, plasma, fiber optics, electromagnetic interference, electromechanical energy conversion, radar meteorology, remote sensing, permanent magnet, transformers, electric relays, radio / TV, telephone, electric motors, transmission lines, waveguides, radar, laser, etc.

Learning Goal

For the first step, students are requested to obtain perfect knowledge of the laws and principles of EM, and practical skills for solving basic EM problems by choosing pertinent laws and principles of EM.

Course Content

The basis of EM is the knowledge of electrons in free space and substances. Important points are following. Electrons behave as particles (m:$9.1\times10^{-31}kg$,e:$1.6\times10^{-19}C$) and waves with characteristic kinetic energy and wave numbers ($\hbar^2k^2/2m$, for which $\hbar$, k are Plank's constant ($\hbar = h/2\pi$) and wave number, respectively). Electrons also possess both charges and spins.

The fundamental physical properties of solids depend upon the static distributions and dynamic motions of carriers. The motions of carriers such as velocity and angular momentum are described with vectors. Therefore, the vector analysis is ***indispensable*** to understand the EM.

Oct. 7	Prof. T. Fujiwara	1: Introduction and outline
Oct. 14	Prof. T. Fujiwara	2: Vector Analysis 2.1: Vector Algebra
Oct. 21	Prof. T. Fujiwara	2.2: Differential Calculus
Oct. 28	Prof. T. Fujiwara	2.3: Integral Calculus -1
Nov. 4	Prof. T. Fujiwara	2.4: Integral Calculus -2
Nov. 11	Prof. T. Fujiwara	2.5: Curvilinear Coordinates
Nov. 25	Prof. T. Otsuji	3: Electro Statics 3.1: The Electric Field 3.2: Divergence and Curl (Rotation) of Electrostatic Field
Dec. 2	Prof. T. Otsuji	3.3: Electric Potential 3.4: Work and Energy in Electrostatics
Dec. 9	Prof. T. Otsuji	3.5: Conductors
Dec. 16	Prof. T. Otsuji	4: Special Techniques 4.1: Laplace's Equation
Jan. 6	Prof. T. Otsuji	4.2: The Method of Images
Jan. 13	Prof. T. Otsuji	4.3: Separation of Variables
Jan. 20	Prof. T. Fujiwara	5: Magneto Statics 5.1: The Biot-Savart Law
Jan. 27	Prof. T. Fujiwara	5.2: Applications of Ampere's Law (5.3.3)
Feb. 3		6: Final Exam.

Assessment Criteria
Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D.....Failure (0-59%)
Students will be evaluated based on: class attendance, presentations, in-class participation, homework assignments, reports and the final exam.

Textbook
None, print+handout
Note
High attendance is required to keep the progress of the projects. Notebook Computer is used for solving practices.

Introductory Quantum Mechanics

Assoc. Prof. Simon J. GREAVES
Contact address simon@riec.tohoku.ac.jp

Place: Room 2C, Electrical, Information and Physics Engineering Building No. 1 (D10 on the campus map).
Time: Fridays 1 pm - 2:30 pm

Beginning with a review of some early 20th century experiments, this course aims to develop an understanding of the basic concepts of quantum mechanics and how they differ from classical mechanics. The Schrodinger equation will be used to solve one-dimensional problems and show that quantum mechanics can be used to predict the existence of physical phenomena such as quantum mechanical tunneling, discrete energy levels and energy band-gaps in solids. Students are assumed to have introductory college-level physics, calculus, and linear algebra.

Course grades are based on homework, mid-term and final examinations.

The lecture notes, homework and class schedule can be found on the web page http://www.kiroku.riec.tohoku.ac.jp/simon/quantum

Course Outline

The first class is on Friday the 2nd of October. Please see the web page for scheduling of subsequent classes. A brief outline of the contents of each lecture is given below.

1. Introduction. What is quantum mechanics and how does it differ from classical mechanics? Double slit experiments are used to demonstrate the differences.

2. Blackbody radiation. How can we explain the distribution of light emitted by black bodies, such as the sun? Photoelectric effect: the energy carried by a photon can be converted into electrical current. This is the basis of solar cell operation.

3. Compton scattering. When a photon interacts with an electron we can treat the problem using relativistic mechanics. Franck and Hertz experiment: electron energy levels in gases can be determined using this simple experiment.

4. Bohr's model of the hydrogen atom. A simple model is used to calculate the energy levels of the electron in a hydrogen atom. de Broglie theory: all matter has a wavelength that can be calculated using the de Broglie theory. The Davisson-Germer experiment is used to demonstrate the validity of de Broglie's theory.

5. Schrödinger equation. the Schrödinger equation is introduced in its time dependent and time independent forms. Wavefunctions are solutions to the Schrödinger equation. We look at how to normalise wavefunctions and learn about the Born interpretation of the wavefunction.

6. Operators and eigenvalue equations. The Schrödinger equation is an eigenvalue equation for energy. Using appropriate operators we can derive similar eigenvalue equations for momentum and other physical observables. Expectation values: given an ensemble of particles in the same initial state the expectation value is the average value of a particular property, e.g. position, momentum, energy etc.

7. The infinite potential well. A simple one-dimensional problem of a particle trapped in an infinitely deep well is solved using the Schrödinger equation.

8. Pauli exclusion principle, particle in a box, Heisenberg uncertainty principle. The Pauli exclusion principle requires that all particles have different wavefunctions. If many particles are placed in a box the Pauli exclusion principle leads to a "degeneracy pressure" that resists compression of the box. The Heisenberg uncertainty principle tells us that the more accurately we try to measure the position of an object, the less we know about its momentum, and vice-versa.

9. Delta-function potential, scattering and tunneling. Quantum mechanical tunneling is used in many devices but cannot be explained by classical mechanics. A delta-function potential is used and the Schrödinger equation solved to show that quantum mechanics can account for this effect. Some applications of quantum mechanical tunneling are reviewed.

10. One dimensional barrier problems. The Schrödinger equation is solved for various one dimensional problems, e.g. finite barrier, finite well, step potential.

11. Solids, band gaps, angular momentum. The Schrödinger equation is used to solve a 1D periodic potential problem which is used to represent atoms in a solid. The solution demonstrates that the periodic potential leads to the creation of energy bands and band gaps.

12. The harmonic oscillator. This problem is used to represent the vibration of atomic nuclei in a solid. The solution shows that the atoms can only take certain energies and that their energy is not zero, even at a temperature of absolute zero.

13. Free particles and wave packets. Solving the Schrödinger equation for a Gaussian wave packet shows that the width of the packet will increase as it propagates.

Textbook

There is no set text. Many textbooks cover the topics discussed in the course, e.g.

David J. Griffiths, Introduction to Quantum Mechanics, Prentice Hall International.

Richard L. Liboff, Introductory Quantum Mechanics, Addison Wesley.

B. H. Bransden & C. J. Joachain, Quantum Mechanics, Prentice Hall.

Course Title	**Basic Computer Science**
Semester	Fall
Credit	2
Instructor	Assoc. Prof. Takehiro Ito, Assoc. Prof. Naoaki Okazaki, Assoc. Prof. Hiroki Nishiyama, Assoc. Prof. Takeshi Obayashi
E-mail	takehiro@ecei.tohoku.ac.jp, okazaki@ecei.tohoku.ac.jp, bigtree@it.is.tohoku.ac.jp, obayashi@ecei.tohoku.ac.jp
Time and Day	Friday, 14:40-16:10 Starting on October 2.
Place	Lecture Room 2A, Electrical, Information and Physics Engineering Building No.1, Aobayama Campus.

Course Objectives and Outline

This course provides a quick overview of four research fields of computer science to bridge fundamental theories of computer science with the cutting-edge research in our department. The course consists of four parts (given by four instructors): communication network, natural language processing, bioinformatics, and algorithm theory.

Learning Goal

Students will come to understand the association between the fundamental knowledge about computer science and the research activities. The emphasis will be on giving a broad overview of the research areas in computer science.

Course Content

Refer to the course schedule.

Oct 2	Nishiyama	1. Course Orientation Basic Technologies for Communication Networks
Oct 9	Nishiyama	2. Next Generation Networks 1
Oct 23	Nishiyama	3. Next Generation Networks 2
Nov 6	Okazaki	4. Introduction to Natural Language Processing
Nov 13	Okazaki	5. Statistical approach
Nov 20	Okazaki	6. Machine-learning approach
Dec 11	Obayashi	7. Computational Biology 1 Encode and decode biosystems
Dec 18	Obayashi	8. Computational Biology 2 Genetic history of human
Dec 25	Obayashi	9. Computational Biology 3 Genetic diversity and adaptive evolution
Jan 8	Ito	10. Algorithm Theory 1 What is algorithm? Power of "efficient" algorithms
Jan 15	Ito	11. Algorithm Theory 2 How to evaluate algorithms
Jan 22	Ito	12. Algorithm Theory 3 Basic techniques for algorithms

Assessment Criteria
Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D.....Failure (0-59%)
Attendance and writing assignments. Details will be announced by each instructor.

Textbook
None, print+handout