Mathematics Tutorial Ia (1.0credits) (数学演習１ａ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Autumn Semester	1 Autumn Semester	1 Autumn Semester
	1 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	RICHARD Serge Charles Designated Professor		

●Course Purpose

The aim of this course is to deepen the understanding of calculus and to cultivate the ability to apply mathematical knowledge. The course is mainly intended for students taking Calculus I.

●Prerequisite Subjects

Calculus I

●Course Topics

Exercises sheets will be provided each week before the tutorial, and will be available on the web site of the course.Homework will be due every week during the tutorial. For more information:http://www.math.nagoya-u.ac.jp/richard/fall2018.html

●Textbook

order it during a class as needed

●Additional Reading

do not appoint the textbook, but distribute a lecture document by a class of every time

●Grade Assessment

Your final grade will be determined by homework (50%) and quizzes (50%).

●Notes

●Contacting Faculty

Email to : richard@math.nagoya-u.ac.jp

Mathematics Tutorial Ib (1.0credits) (数学演習１ｂ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Autumn Semester	1 Autumn Semester	1 Autumn Semester
	1 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	Erik Darpö Designated Associate Professor		

●Course Purpose
The aim of this course is to provide essential mathematical knowledge necessary to further study mathematics andother sciences at university level. The course is intended for students taking Linear algebra I.

●Prerequisite Subjects
The course is intended for students taking Linear algebra I.

●Course Topics
1. Geometric setting : points and vectors in Rn, located vectors in Rn, scalar product in Rn, norm and scalar product in Rn, parametric representation of a line, planes and hyperplanes. 2. Matrices and linear equations: matrices, homogeneous linear equations, row operations and Gauss elimination, elementary matrices. 3. Vector spaces: abstract definition, linear combinations, convex sets, linear independence, dimension, the rank of a matrix. 4. Linear maps: general maps, linear maps, kernel and range of linear maps, rank and linear maps, matrix associated with a linear map, composition of linear maps, inverse of a linear map.It is desirable to read a textbook or reference materials before a class

●Textbook
I do not appoint the textbook

●Additional Reading
Otto Bretscher: Linear Algebra with Applications, fourth edition, Pearson 2009.ISBN: 978-0-13-600926-9

●Grade Assessment
The assessment of this course coincides with the assessment of the course Linear Algebra II.Any student who does not participate in the final exam will receive the grade “Absent”.

●Notes
do not need the study condition

●Contacting Faculty
Phone: 052-789-5612Office: A-331, Science building A.

Fundamental Physics Tutorial I a (1.0credits) (物理学基礎演習１ａ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Autumn Semester	1 Autumn Semester	1 Autumn Semester
	1 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	SHIGEMORI Masaki Designated Professor		

●Course Purpose

This is the companion course to the lecture course Fundamentals of Physics I on introductory calculus-based mechanics. It offers exercises to cultivate the ability to analyze and solve problems, as well as presentation and discussion skills so as to participate effectively in discussions among peers and instructors, leading to mastering the concepts introduced in the lecture course. Therefore students taking the lecture course are expected to register for this tutorial course.

●Prerequisite Subjects

Fundamentals of Physics I; Calculus I

●Course Topics

See syllabus for Fundamentals of Physics I

●Textbook

Students are required to purchase the online Fundamentals of Physics Extended 10th Edition International StudentVersion with WileyPLUS Set (John Wiley & Sons, 2010ISBN:9780470576083) [However, do not purchase it beforethe first class meeting where further details will be announced in class]

●Additional Reading

order it during a class as needed

●Grade Assessment

GradingAttendance and Class participation: 40%   Assignments and Quizzes: 60%Class attendance is required. Absentee must give a valid reason, supported with document. A student will receive an “Absent” grade if he is absent 2 or more times without valid reason.

●Notes

There are no prerequisites

●Contacting Faculty

By appointment. Please email instructors to make an appoinment.

Fundamental Physics Tutorial I b (1.0credits) (物理学基礎演習１ｂ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Autumn Semester	1 Autumn Semester	1 Autumn Semester
	1 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	TAMA Florence Muriel Professor		

●Course Purpose

This is a companion course to Fundamental Physics II, and offers practical exercises for mastering the concepts introduced in the lecture courses. Students taking the lecture courses should also take this tutorial class

●Prerequisite Subjects

Related CoursesCalculus I; Fundamentals of Physics I ; Fundamentals of Physics II

●Course Topics

Course ContentsSee syllabus for Fundamental Physics II.

●Textbook

Fundamentals of Physics Extended 10th Edition International Student Version with WileyPLUS Set (John Wiley & Sons, 2010 ISBN: 9781118230749)

●Additional Reading

Instructions will be given as necessary in class

●Grade Assessment

GradingWeekly assignments; attendance; class participation. (Weighting to be advised.)Criteria for “Absent” & “Fail” Grades• Class attendance is required. Absentees must give a valid reason (e.g. doctor’s certificate). A student who is absent from more than 3 sessions will receive zero for the semester attendance mark.• The “Absent” grade is reserved for students who withdraw by November 16. After that day, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes

There are no prerequisites

●Contacting Faculty

By email: florence.tama@nagoya-u.jp

Mathematics Tutorial II a (1.0credits) (数学演習２ａ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	RICHARD Serge Charles Designated Professor		

●Course Purpose
The aim of this course is to deepen the understanding of calculus and to cultivate the ability to apply mathematical knowledge. The course is mainly intended for students taking Calculus II.

●Prerequisite Subjects
Calculus II, G30 program

●Course Topics
Exercises sheets will be provided each week before the tutorial, and will be available on the web site of the course. Homework will be due every week during the tutorial.

●Textbook
No textbook is required for this tutorial.

●Additional Reading
No reference book is required for this tutorial.

●Grade Assessment
Your final grade will be determined by homework (40%) and quizzes (60%).

●Notes
do not need the study condition

●Contacting Faculty
Email to : richard@math.nagoya-u.ac.jp

Mathematics Tutorial II b (1.0credits) (数学演習２ｂ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	Erik Darpö Designated Associate Professor		

●Course Purpose
The objective of this course is to provide essential mathematical knowledge necessary to further studies in mathematics and science at university level. The course is primarily intended for students taking the course Linear algebra II.

●Prerequisite Subjects
Linear Algebra II

●Course Topics
Orthogonal maps, vector spaces, determinants and their applications, eigenvalues and eigenvectors, applications of eigenvalue theory, linear differential equations.

●Textbook
do not appoint the textbook

●Additional Reading
Otto Bretscher: Linear Algebra with Applications, fourth edition, Pearson

●Grade Assessment
Explained during the first class

●Notes
While not a formal requirement, Linear Algebra I is strongly recommended.

●Contacting Faculty
Email: darpo@math.nagoya-u.ac.jp

Fundamental Physics Tutorial Ⅱａ (1.0credits) (物理学基礎演習２ａ)

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester		
Elective/Compulsory	Elective	Compulsory	Elective
	Elective		
Lecturer	John A. WOJDYLO Designated Professor		

●Course Purpose

The aims of this course are to deepen students' understanding of basic Physics ofelectricity and magnetism and to cultivate their ability to apply Physics knowledge to problem-solving.

●Prerequisite Subjects

Fundamentals of Physics

●Course Topics

1. Electric Charge and Electric Fields 2. Gauss' Law 3. Electric Potential 4. Capacitance, Current, Resistance and Circuits 5. Magnetic Fields 6. Induction and InductanceIt is desirable to read a textbook or reference materials before a class

●Textbook

Fundamentals of Physics David Halliday, Robert Resnick, Jearl Walker John Wiley & Sons Inc

●Additional Reading

Instructions will be given as necessary in class

●Grade Assessment

Class attendance is required. Absentee must give a valid reason.Class Attendance: 10%; Assignments, quizzes and other assessment (written, presentation, etc.): 90%

●Notes

There are no prerequisites

●Contacting Faculty

Fundamental Physics Tutorial Ⅱｂ（1.0credits)（物理学基礎演習２ｂ）

Course Type	Basic Specialized Courses		
Class Format	Exercise		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester		
Elective/Compulsory	Elective	Compulsory	Elective
	Elective		
Lecturer	Bernard GELLOZ Designated Associate Professor		

●Course Purpose

The aims of this course are to deepen students’ understanding of basic Physics of waves and optics, and to cultivate their ability to apply Physics knowledge.

●Prerequisite Subjects

Fundamentals of Physics

●Course Topics

1. Oscillations2. Introduction to Maxwell’s Equations3. Waves4. Electromagnetic Waves5. Images 6. Interference & DiffractionIt is desirable to read a textbook or reference materials before a class

●Textbook

Fundamentals of Physics David Halliday, Robert Resnick, Jearl Walker John Wiley & Sons Inc

●Additional Reading

Instructions will be given as necessary in class

●Grade Assessment

Class attendance is required. Absentee must give a valid reason.Class Attendance: 10%; Assignments, quizzes and other written assessment: 90%.

●Notes

Fundamentals of Physics

●Contacting Faculty

Fundamentals of Biology II (2.0credits) (生物学基礎２)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	1 Spring Semester
Elective/Compulsory	Elective
Lecturer	Maria VASSILEVA Designated Associate Professor

●Course Purpose

This course`s main goal is to provide students with working understanding on how human body functions and the ability to use this knowledge in everyday health-related situations. The course focuses on human anatomy and physiology, but also on how organ systems' organization has changed throughout animals' evolution. Short introduction is given on plant morphology and physiology, as well as on basic concepts of ecology. The overview of plants and interactions of ecological systems will allow students to critically evaluate agricultural and ecological issues.

●Prerequisite Subjects

There is no prerequisite knowledge for this course, so even those who didn't take Fundamentals of Biology 1, or didn't study Biology in high school, are welcome to join and learn how human body works.

●Course Topics

1. Animals1.1 Unifying concepts of animal structure and function1.2 Nutrition and digestion1.3 Gas exchange1.4 Circulation1.5 The immune system1.6 Control of body temperature and water balance1.7 Hormones and the endocrine system1.8 Reproduction and embryonic development1.9 Nervous system1.10 The senses1.11 How animals move2. Plants2.1 Plant structure, growth and reproduction2.2 Plant nutrition and transport2.3 Control systems in plants 3. Ecology3.1 The biosphere: an introduction to Earth`s diverse environments3.2 Behavioral adaptations to the environment3.3 Population ecology3.4 Communities and ecosystems3.5 Conservation biologyIt is desirable to read a textbook or reference materials before a class

●Textbook

The same textbook will be used as in Fundamentals of Biology 1Campbell Biology: Concepts & Connections, 7th Ed.Jane B. Reece / Martha R. Taylor / Eric J. Simon / Jean L. DickeyBenjamin Cummings, 2011Mastering Biology (www.masteringbio.com) is an online system that accompanies the textbook for this course. Course login details will be given at the first lecture. This system will not be integrated into the course assessment methods. The choice of using it will be left to each individual student.

●Additional Reading

order it during a class as needed

●Grade Assessment

Evaluation will be based on in-class participation (total of 20% of the final grade) and two exams (total of 80% for both). Attendance will not be marked.In-class participation will consist of active participation in discussions and quality of presentations and in-group assignments. There will be no periodic home works or quizzes; instead students are expected to read the appropriate chapter before class, as classes will include problem-solving questions and discussions. Exams will emphasize on analytical and problem-solving questions.

●Notes

do not need the study condition

●Contacting Faculty

VASSILEVA MariaOffice : School of Science, building E, room 202Phone : 789-3530E-mail : mnvassileva@bio.nagoya-u.ac.jp

Mathematics I and Tutorial (4.0credits) (数学１及び演習)

Course Type	Basic Specialized Courses		
Class Format	Lecture and Exercise		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	2 Autumn Semester	2 Autumn Semester	2 Autumn Semester
Elective/Compulsory	Compulsory	Compulsory	Compulsory
Lecturer	John A. WOJDYLO Designated Professor	ABE Tomohiro Designated Assistant Professor	

●Course Purpose

5th period

This course is a companion course to Mathematical Physics II. This course introduces first order and second order ordinary differential equations and their solution methods. Students master analytical techniques for problems that arise in physics, engineering and chemistry. Questions of uniqueness of solutions and convergence are also discussed. Students are also introduced to Fourier series, the Fourier transform, convolution, Laplace transform, and the Dirac delta function. Students will find this mathematical methods course helpful in other units such as Quantum Mechanics, Analytical Mechanics, Electricity and Magnetism, as well as in Automotive Engineering and other engineering courses.

This course has dual aims: 1) to convey mathematical principles; 2) to improve students’ technical ability – i.e. ability to express intuition in mathematical terms and ability to solve problems.

4th period

Students taking Mathematical Physics I should also take this tutorial class. This course introduces first order and second order ordinary differential equations and their solution methods. Students master exact and approximate analytical techniques for initial value problems that arise in physics, engineering and chemistry. Questions of existence, uniqueness and convergence are also discussed. Fourier series follow naturally from the 2nd order theory and these are investigated, too.

●Prerequisite Subjects

Prerequisites

Calculus I; Calculus II; Linear Algebra I; Linear Algebra II, or Consent of Instructor

Related Courses

Mathematical Physics Tutorial I, Mathematical Physics II

●Course Topics

Course Outline

• First order ordinary differential equation (ODE) initial value problems. Integration factor; separable equations; systems of ODEs (Hamiltonian systems); phase plane, flow. Uniqueness and existence theorems. Some differences between linear and nonlinear ODEs.

• Second order linear ODE initial value problems. Homogeneous solution. Proving linear independence (Wronskian). Method of Undetermined Coefficients; Variation of Parameters. Series solutions: ordinary point, regular singular point; convergence tests; Method of Frobenius. Examples from physics, engineering and chemistry.

• Fourier series. Dirichlet conditions. Role of symmetry. Gibbs phenomenon. Effect of jump discontinuity on speed of convergence. Integration and differentiation of Fourier series.

• Fourier transform, convolution, Dirac delta function. Laplace transform.

It is desirable to read a textbook or reference materials before a class

●Textbook

oyce W., DiPrima R, Elementary Differential Equations, 7th –10th Ed., Wiley.

●Additional Reading

4th period

1. Boas M.L., 2006, Mathematical Methods in the Physical Sciences, 3rd ed., John Wiley & Sons.

2. Strang, G., Introduction to Linear Algebra, 4th Edition, Chapter 6.

3. Arfken G.B. & Weber H.J., 2005, Mathematical Methods for Physicists, 6th ed., Elsevier Academic Press. (Copies are available in the library.)

5th period

1. Boas M.L., 2006, Mathematical Methods in the Physical Sciences, 3rd ed., John Wiley & Sons.
2. Strang, G., Introduction to Linear Algebra, 4th Edition, Chapter 6.
3. Arfken G.B. & Weber H.J., 2005, Mathematical Methods for Physicists, 6th ed., Elsevier Academic Press. (Copies are available in the library.)

●Grade Assessment

4th period
tutorial Attendance: 50%; Class performance: 50%

5th period
Attendance: 5%; Weekly Quizzes and Assignments: 25%; Mid-term exam: 35%; Final Exam: 35%

●Notes

Calculus I; Calculus II; Linear Algebra I; Linear Algebra II, or Consent of Instructor

●Contacting Faculty

4th period
Office: BuES ilding, ES617
Email: abetomo@kmi.nagoya-u.ac.jp

5th period
Office: Science Hall 5F 517
Phone: 052-789-2307
Email: john.wojdylo@s.phys.nagoya-u.ac.jp

Mathematics II and Tutorial (4.0credits) (数学２及び演習)

Course Type	Basic Specialized Courses		
Class Format	Lecture and Exercise		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	2 Autumn Semester	2 Autumn Semester	2 Autumn Semester
Elective/Compulsory	Compulsory	Compulsory	Compulsory
Lecturer	TakaakiFUJITA Professor	SONNENSCHEIN Volker Thomas Assistant Professor	

●Course Purpose
This course introduces students to vector analysis and partial differential equations, expecting their applications to advanced engineering, such as those related to mechanics and electromagnetics, and those to materials and heat transfer phenomena. The purpose of the course is to acquire fundamental knowledge in vector analysis and partial differential equations and enable students to apply it to solve actual engineering issues through intensive exercises.
Targets
1. Enable to solve basic problems on vector analysis.
2. Enable to solve basic problems on partial differential equations.

●Prerequisite Subjects
Calculus I, II
Linear Algebra I, II

●Course Topics
1. Vector algebra　2. Vector differential operations
3. Curved lines and curved surfaces　4. Gradient, divergence and rotation
5. Line integrals and surface integrals
6. Gauss theorem, Stokes theorem and Green's theorem
7. Irrotational (conservative) field and solenoidal field
8. Curvilinear coordinate systems (cylindrical coordinates and spherical coordinates)
9. Poisson's equation and Green function
10. Separation of variables: Laplace equation, diffusion equation and wave equation

Students are expected to review the distributed notes after lectures. Students need to submit reports on the problems presented in the lecture. The solutions of the problems will be presented in the lecture where reports are returned, through which students are expected to deepen their understanding.

●Textbook
Not specified. Notes are distributed during the lecture.

●Additional Reading
Mathematical Methods for Physicists, sixth edition, by G. B. Arfken and H. J. Weber,
Elesevier, 2005 (ISBN: 0-12-088584-0)
Mathematical Methods in the Physical Sciences, by Mary L. Boas,
Wiley, 2006 ((ISBN: 978-0471198260)

●Grade Assessment
Reports: (50%)
Examinations: (50%)
Students need to obtain at least 60% of the total marks to pass the course.

●Notes
None.

●Contacting Faculty

Office: Bld. No. 8 south, Room No. 407,
Phone: 052-789-4593,
E-mail : fujita@energy.nagoya-u.ac.jp

Analytical Mechanics I (2.0credits) (解析力学１)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	2 Autumn Semester	2 Autumn Semester
Elective/Compulsory	Elective	Compulsory
Lecturer	SHIGEMORI Masaki Designated Professor	

●Course Purpose

This is the first of two courses in analytical mechanics. Analytical mechanics abstracts from Newtonian machanics and generalizes it to a beautiful and versatile framework that can be applied to various areas of physics, such as quantum mechanics, statistitical mechanics, and relativity. After a survey of elementary princples, we discuss the core concepts of Lagrangian and Hamiltonian mechanics, with special emphasis on symmetry principles, followed by some explicit examples.

●Prerequisite Subjects

Analytical Mechanics II, Quantum Mechanics I

●Course Topics

1. Survey of elementary principles2. Variational principles and Lagrangian mechanics3. Symmetries and conservation laws4. Hamiltonian mechanics5. Central force problemIt is desirable to read a textbook or reference materials before a class

●Textbook

H. Goldstein, C. Poole and J. Safko, "Classical Mechanics", Pearson; 3rd edition (2013), ISBN-10: 1292026553,ISBN-13: 978-1292026558

●Additional Reading

L. D. Landau and E. M. Lifschitz, "Mechanics: Volume 1 (Course of Theoretical Physics)", Butterworth-Heinemann; 3rdedition (1976), ISBN-10: 0750628960, ISBN-13: 978-0750628969.L. N. Hand and J. D. Finch, "Analytical Mechanics", Cambridge University Press (1999), ISBN-10: 0521575729,ISBN-13: 978-0521575720.

●Grade Assessment

Will be based on attendance, homework and exams (The details will be announced in class)

●Notes

Calculus I & II, Fundamentals of Physics I &II, and concurrent registration of Mathematical Physics I & II

●Contacting Faculty

Statistical Physics I (2.0credits) (統計物理学１)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	2 Autumn Semester	2 Autumn Semester
Elective/Compulsory	Elective	Compulsory
Lecturer	HOSSAIN Akter Designated Lecturer	

●Course Purpose

The purpose of Statistical Physics I is to understand the basic laws that govern macroscopic bodies consisting of an enormous number of atoms and molecules. This first part of the course covers universal phenomenological laws, called thermodynamic laws, and their applications.

The main focus of this course is to understand the basic principles of classical thermodynamics which are the basis for macroscopic understanding of all the physical phenomena. The applications in automotive engineering are also introduced.

●Prerequisite Subjects

Calculus

●Course Topics

1.Thermal Equilibrium and Temperature
2.State Equations, Partial Differentials, Units and Dimensions
3.The First Law of Thermodynamics (energy, isothermal and adiabatic processes)
4.The Second Law of Thermodynamics
5.Entropy
6.Thermodynamic Functions
7.Phase Equilibrium and Chemical Equilibrium
8.Kinetic Theory and Statistical Mechanics

Remarks: To obtain an excellent grade of this course, you have to prepare yourself properly by allocating enough time (i.e., it is your own duty/responsibility) for the assignment and final examination outside the course hours using the printed handouts of the lecture materials.

●Textbook

Printed handouts will be provided.

●Additional Reading

Modern Engineering Thermodynamics; Robert T. Balmer; Academic Press (2010)

●Grade Assessment

Grades will be based on class participation, assignments and a final examination.
30% for attendance
30% for assignments
40% for final examination

●Notes

The whole lecture schedules/plans (including the date of the assignment/report, and the date of the final examination and so on) will be announced at the first class of each semester. The contents of the lecture, based on the course topics, will be provided in every lecture. However, the items as stated above are subject to change with prior notice during the semester.

●Contacting Faculty

Students can ask questions at any time during classes.
Questoins during off-class hours can be asked at the lecturer's room (Engineering Building No.3 North

Wing, Room 223 (3125) or via e-mail: akter.hossain@mae.nagoya-u.ac.jp

Physics Tutorial Ia (0.5credits) (物理学演習１ａ)

Course Type	Basic Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Makoto KUWAHARA Associate Professor

●Course Purpose
Theoretical formalism using Lagrangians and Hamiltonians is very useful for studying the motion of dynamical systems consisting of point particles and rigid bodies. In this lecture, students will gain an understanding of fundamental principles of theoretical formalism and learn technical aspects through simple applications.

●Prerequisite Subjects
Related Courses
Analytical Mechanics I

●Course Topics
Students learn to apply the principles and methods taught in the lecture to analyze and solve problems under the guidance of the instructor, and to participate actively in class discussions. Students are required to hand in regular assignments.

●Textbook
John R. Taylor, Classical Mechanics (University Science Book, 2005)

●Additional Reading
These reference books are available in the Main Library
1. H. Goldstein, Poole & Safko, Classical Mechanics (Addison Wesley, 2002)
2. R. D. Gregory: Classical Mechanics (Cambridge, 2008)
3. J.B. Marion, Classical Dynamics of Particles and Systems (Academic Press, 1965)
4. G. R. Fowles: Analytical Mechanics (1962)

●Grade Assessment
Grading: Assignment 50%, Class Participation: 30%, Final Exam: 20%
Criteria for “Absent” & “Fail” Grades: Class attendance is required. Absentee must give a valid reason. A student will receive an “Absent” grade if he is absent from class more than 2 times or he is absent without valid reason from the Final Exam. A student who is NOT “Absent” but wishes to receive an “Absent” grade must see the instructor immediately after the Final Exam.

●Notes
None

●Contacting Faculty
KUWAHARA Makoto
Office: Eng. Bldg.3, room 453
Phone: 052-789-3597
Email: kuwahara@imass.nagoya-u.ac.jp

Physics Tutorial Ib (0.5credits) (物理学演習１ｂ)

Course Type	Basic Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	HOSSAIN Akter Designated Lecturer

●Course Purpose

The purpose of this course is to deepen students’ understanding of thermodynamics/statistical physics 1, and cultivate their calculation skills by solving basic problems

●Prerequisite Subjects

Calculus

●Course Topics

Students will solve the basic problems under faculty guidance.

1.Thermal Equilibrium and Temperature
2.State Equations, Partial Differentials, Units and Dimensions
3.The First Law of Thermodynamics (energy, isothermal and adiabatic processes)
4.The Second Law of Thermodynamics
5.Entropy
6.Thermodynamic Functions
7.Phase Equilibrium and Chemical Equilibrium
8.Kinetic Theory and Statistical Mechanics

Remarks: To obtain an excellent grade of this course, you have to prepare yourself properly by allocating enough time (i.e., it is your own duty/responsibility) for the assignment and final examination outside the course hours using the printed handouts of the lecture materials.

●Textbook

Printed handouts will be provided.

●Additional Reading

Modern Engineering Thermodynamics; Robert T. Balmer; Academic Press (2010)

●Grade Assessment

Grades will be based on participation, assignments, and a final examination.

30% for attendance
30% for assignments
40% for final examination

●Notes

The whole lecture schedules/plans (including the date of the assignment/report, and the date of the final examination and so on) will be announced at the first class of each semester. The contents of the lecture, based on the course topics, will be provided in every lecture. However, the items as stated above are subject to change with prior notice during the semester.

●Contacting Faculty

Students can ask questions at any time during classes.
Questoins during off-class hours can be asked at the lecturer's room (Engineering Building No.3 North Wing, Room 223
(3125) or via e-mail: akter.hossain@mae.nagoya-u.ac.jp

Electricity and Magnetism (2.0credits) (電磁気学)

Course Type	Basic Specialized Courses		
Class Format	Lecture		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
Starts 1	2 Spring Semester	2 Spring Semester	2 Spring Semester
Elective/Compulsory	Elective	Compulsory	Compulsory
Lecturer	John A. WOJDYLO Designated Professor		

●Course Purpose

This course is a solid introduction to electrostatics and magnetostatics. Maxwell's Equations are derived. The course also introduces students to fundamental mathematical methods required to solve problems in physics, engineering and applied mathematics. This course has dual pedagogical aims: 1) to convey physical principles; 2) to improve students' technical ability – i.e. ability to express physical intuition in mathematical terms and ability to solve problems.

●Prerequisite Subjects

Calculus I&II; Fundamentals of Physics III&IV; Mathematical Physics II or Consent of Instructor.Physics Tutorial IIa

●Course Topics

Course Contents• Revision of vector calculus, curvilinear coordinates, Dirac Delta Function.• Electrostatics. Coulomb's Law. Continuous Charge Distributions. Divergence and Curl of Electrostatic Fields. Field Lines, Flux, and Gauss's Law. Electric Potential. Poisson's Equation and Laplace's Equation. The Potential of a Localized Charge Distribution. Work and Energy in Electrostatics. Conductors. Induced Charges. Surface Charge and the Force on a Conductor. • Special Techniques. The Method of Images: point charge near a conducting plane or sphere, grounded or insulated. Separation of Variables.• Electric Fields in Matter. Polarization. Dielectrics. The Electric Displacement. Linear Dielectrics. • Magnetostatics. The Lorentz Force Law. The Biot-Savart Law. The Divergence and Curl of B. Applications of Ampere's Law. Magnetic Vector Potential A. What is "real", A or B?• Magnetic Fields in Matter. Magnetization. Diamagnetism, Paramagnetism, Ferromagnetism. The Auxiliary Field H. Magnetic Susceptibility and Permeability. • Introduction to Electrodynamics. Electromotive Force. Electromagnetic Induction. Faraday's Law. Energy in Magnetic Fields. Maxwell's Equations. Magnetic levitation above a superconductor.It is desirable to read a textbook or reference materials before a class

●Textbook

1. Griffiths, D.L., 2012, Introduction to Electrodynamics, 4th ed., Prentice Hall.Alternative textbook (HIGHLY RECOMMENDED -- many copies in the G30 section of the Science Library):2. Nayfeh, M. H. & Brussel M. K., Electricity and Magnetism, Dover, 2015.(It is essential that students read at least one of these books. Nayfeh is much cheaper to buy and the explanations are clearer. It covers what we need for EM1.)

●Additional Reading

Leighton, R.B. & Feynman, R.P., Feynman Lectures on Physics (Volume 2), Pearson. (Highly recommended alternative reading.)

●Grade Assessment

Attendance: 5%; Weekly quizzes or other written assessment: 15%; Mid-term exam: 40%; Final Exam: 40%
The "Absent" grade is reserved for students who withdraw by May 16. After that day, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes

Calculus I&II; Fundamentals of Physics III&IV; Mathematical Physics II or Consent of Instructor.Physics Tutorial IIa

●Contacting Faculty

Office: Science Hall 5F 517Phone: 052-789-2307Email: john.wojdylo@s.phys.nagoya-u.ac.jp

Quantum Mechanics I (2.0credits) (量子力学１)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	SHIGEMORI Masaki Designated Professor

●Course Purpose

Quantum mechanics governs the microscopic aspects of nature and is more fundamental than the classical mechanics which is an approximate effective theory describing the macroscopic aspects of nature. This course aims to develop solid understanding and basic knowledge of quantum mechanics, which is absolutely necessary in various fields of modern physics.We start by introducing fundamental notions such as the wave function and the Schrödinger equation, and familiarize ourselves with them by studying 1-dimensional problems. Then, after developing the formalism of quantum mechanics, we discuss three dimensional problems such as the hydrogen atom.

●Prerequisite Subjects

Fundamentals of Chemistry I and II, Fundamentals of Physics I to IV, Calculus I and II, Linear Algebra I and II, or permission of the instructor

●Course Topics

1 From Classical to Quantum Mechanics (Ch. 1)2 Wave Packets and the Schrodinger Equation (Ch. 2)3 The Quantum Mechanical Postulates (Ch. 3)4 Pre-exam Review & EXAM 1 (Ch. 1 – 3)5 The Particle in the Box 1 (Ch. 4)6 The Particle in the Box 2 (Ch. 5)7 Commuting and Non-commuting Operators and the Uncertainty Principle (Ch. 6)8 Harmonic Oscillator: Classical and Quantum Mechanical 1 (Ch. 7)9 Harmonic Oscillator: Classical and Quantum Mechanical 2 (Ch. 7)10 Pre-exam Review & EXAM 2 (Ch. 4 – 7)11 The Vibrational and Rotational Spectroscopy of Diatomic Molecules 1 (Ch. 8)12 The Vibrational and Rotational Spectroscopy of Diatomic Molecules 2 (Ch. 8)13 The Hydrogen Atom (Ch. 9)14 Pre-final Review15 FINAL EXAM (Ch. 1 – 9)It is desirable to read a textbook or reference materials before a class

●Textbook

T. Engel: Quantum Chemistry and Spectroscopy, 3rd Ed. (International edition), Pearson, 2014

●Additional Reading

order it during a class as needed

●Grade Assessment

Two exams: 100 points each, final exam (comprehensive): 200, homework: 50. TOTAL: 450.

●Notes

do not need the study condition

●Contacting Faculty

Analytical Mechanics II (2.0credits) (解析力学２)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Elective
Lecturer	SHIGEMORI Masaki Designated Professor

●Course Purpose

This course is the continuation of Analytical Mechanics I. Based on the framework developed there, some explicit physical systems and their physics will be studied, such as motion in non-inertial frames, rigid bodies, and small oscillations. Toward the end of the course, special relativity will be introduced and relevant notions will be developed.

●Prerequisite Subjects

Analytical Mechanics I, Mathematical Physics I, and Mathematical Physics IIPhysics Tutorial IIb, Quantum Mechanics II

●Course Topics

1. Mechanics in Non-Inertial Frames 2. Rotational Motion of Rigid Bodies3. Introduction to Collision Theory4. Special RelativityIt is desirable to read a textbook or reference materials before a class

●Textbook

H. Goldstein, C. Poole and J. Safko, "Classical Mechanics", Pearson; 3rd edition (2013), ISBN-10: 1292026553, ISBN-13: 978-1292026558

●Additional Reading

L. D. Landau and E. M. Lifschitz, "Mechanics: Volume 1 (Course of Theoretical Physics)", Butterworth-Heinemann; 3rd edition (1976), ISBN-10: 0750628960, ISBN-13: 978-0750628969.L. N. Hand and J. D. Finch, "Analytical Mechanics", Cambridge University Press (1999), ISBN-10: 0521575729, ISBN-13: 978-0521575720.

●Grade Assessment

Attendance: 5%, homework: 25%, exams (midterm and final): 30%+30%=70%

●Notes

Analytical Mechanics I, Mathematical Physics I & II

●Contacting Faculty

Applied Physics Laboratory I (1.0credits) (応用物理学実験１)

Course Type	Basic Specialized Courses
Class Format	Experiment
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

The course consists of a minimum set of basic experiments on applied physics. Through the experiments, students acquire basic experimental techniques and deepen understandings of the experimental research. The goal is i) to acquire basic expereimental skills, ii) to analyse experimental data correctly and explain them, and iii) to acquire abilities to apply the skills to more advanced experimental research projects.

●Prerequisite Subjects

No prerequisite subject is necessary.

●Course Topics

Following the orientation and a first lecture on experimental data processing, students will be divided into groups of two or three students and conduct one experiment per week on the topics listed below. Assistant professors offer tutorials for each experiment. At the final week, students make their oral presentations about the last experiment.

1. Optical fibers
2. The Stefan-Boltzmann law
3. Digital circuits
4. Analog circuits
5. Planck's constant
6. Elementary electric charge
7. Heat capacity of solids
8. Electric properties of metals and semiconductors
9. Experiments on vacuum
10. Sound-velocity of ultrasonic pulse

Students need to prepare a laboratory report for each of the laboratory assignments and submit it on time.

●Textbook

Basic Experiments in Applied Physics (edited by Dept. of Appl. Phys., Nagoya Univ.).
The textbook is distributed in the first lecture. Students should bring their own experimental notebook, scientific calculator, and graph paper.

●Additional Reading

Books for reference will be introduced as necessary.

●Grade Assessment

Grades will be based on the attendance on the experiments, the report on data processing, all the reports on individual topics, and the presentation. Students must obtain a score of 60/100 or higher to pass the course. Delayed submission of reports will affect the applicable grade.

●Notes

No conditions for taking this class is imposed.

●Contacting Faculty

Contact faculty staffs of each laboratory assignment.

Statistical Physics II (2.0credits) (統計物理学２)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	John A. WOJDYLO Designated Professor

●Course Purpose

This unit is the first half of a full-year course. After learning the mathematical structure of thermodynamics and why thermodynamics works with many examples of systems beyond the ideal gas -- students are introduced toequilibrium statistical mechanics, which describes the equilibrium conditions of systems consisting of a large number of particles. Applications are considered in condensed matter physics, solid state physics, cosmology, chemistry,materials science and biology. Problem-solving is an integral part of the course: students should attend fortnightly tutorials (Physics Tutorial III) where they will discuss many of the assignment questions and receive hints forsolutions. Weaker students are particularly encouraged to attend tutorials and submit assignments. This semester students are thoroughly prepared for quantum statistical mechanics in SP3 next semester. It is recommended that students take Quantum Mechanics II concurrently.At the end of Statistical Physics III next semester students will be adequately prepared with regards to their knowledge of statistical mechanics and thermodynamics to undertake further studies in S-lab, R-lab, TB-lab, E-lab,H-lab, QG-lab and other, including experimental, labs in both the Department of Physics and Department of Applied Physics, as well as chemistry and computational biology labs at Nagoya University. A knowledge of statisticalmechanics (quantum and classical) is essential for students interested in experimental physics, theoretical physics, chemistry and mathematical biology.

●Prerequisite Subjects

Quantum Mechanics II; Physics Tutorial III; Statistical Physics III (next semester). It is strongly advised that students concurrently enroll in Physics Tutorial III.

●Course Topics

Course Contents Callen Chapts 1-8, 15-17, 21 (some parts omitted); Reif Chapts 1-3, 6-7, Appendix A12. Some topics are more fully explored in tutorials. Lectures are recorded on video and will be available on Youtube (private channel).Lecture 1. Fundamental Relation, Entropy Representation; Postulates of the Entropy. Partial derivatives and experiments. Thermodynamic coordinates. Existence of the internal energy thermodynamic potential. Existence of an entropy function of state -- proof from within thermodynamics. Basic postulates of thermodynamics. Nernst Postulate (3rd Law of Thermodynamics.) Fundamental relation in the Entropy representation. Based on Callen Chapter 1; and Zemansky and Dittman Chapter 2.Lecture 2. Top-Down Approach: Equations of State from the Fundamental Relation. Examples. Extensive parameters are homogeneous order 1. Intensive parameters are homogeneous order 0. Thermal and Mechanical Equlibrium. Euler relation. Gibbs-Duhem relation. Based on Callen Chapter 2.Lecture 3. Bottom Up Approach: Fundamental Relation from the Equations of State. Mathematical theorems underlying thermodynamics. Examples of applying compatibility condition, Gibbs-Duhem Relation, Euler Relation, 1st Law in molar form. 2nd Equation of State from van der Waals Equation of State. Example: rubber band; photon gas; Fundamental Relation for one-component ideal gas. Ideal gas: "Gibbs Paradox"? Entropy of a mixture: “entropy of mixing”. Molar heat capacity and other derivatives. Based on Callen Chapter 3.Lecture 4. The Maximum Work Theorem. Possible and impossible processes. Quasistatic and reversible processes – how can temperature be increased reversibly? Heat flow and coupled systems. The maximum work theorem (proof without using Carnot cycle). Carnot Efficiency. Carnot cycle: why is it necessary? Carnot cycle for a photon gas.seehttps://syllabus.sci.nagoya-u.ac.jp/detail/20180680170/It is desirable to read a textbook or reference materials before a class

●Textbook

1. Callen, H., Thermodynamics and an Introduction to Thermostatistics, 2nd ed.,Wiley, 1985. (The central textbookin this course. Japanese translation has fewer typographical errors.)2. Reif, F., Fundamentals of Statistical and Thermal Physics, McGraw-Hill, 1965.Many copies of the textbooks are available in the G30 section of the Science Library.

●Additional Reading

1. Kittel, C., Elementary Statistical Physics, Dover, 2004. Highly recommended. Cheap to buy.2. Kittel, C. and Kroemer, H., Thermal Physics, W.H. Freeman. (Try as alternative.)3. Zemansky, M.W. and Dittman, R.H., Heat and Thermodynamics, An Intermediate Textbook, McGraw-Hill, 1992.(Excellent for empirical basis of thermodynamics.)4. Blundell, S. and Blundell, K., Concepts in Thermal Physics, 2nd Ed., Oxford University Press, 2010. (Elementaryexplanations. Try this as an alternative. Many copies available in the library.)5. Huang, K., Statistical Mechanics, Wiley. (Advanced reference.)6. Landau, L.D. and Lifshitz, E.M., Statistical Physics, Part I, by E.M. Lifshitz and L.P.Pitaevskii, Pergamon Press. (A classicbook: thorough, advanced treatment.)

●Grade Assessment

Attendance: 5%; Weekly quizzes or other written assessment: 30%; Midterm exam: 32.5%; Final Exam: 32.5%The “Absent” grade is reserved for students who withdraw by November 16. Unless there are exceptionalcircumstances, after that day, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes

do not need the study condition

●Contacting Faculty

Email: john.wojdylo@s.phys.nagoya-u.ac.jp

Applied Physics Tutorial II a (1.0credits) (応用物理学演習２ａ)

Course Type	Basic Specialized Courses	
Class Format	Exercise	
Course Name	Fundamental and Applied Physics	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	Masaaki Araidai Assistant Professor	Ai YAMAKAGE Assistant Professor

●Course Purpose
To master various concepts introduced in Statistical Physics II lecture course by solving a number of problems relating to the lecture course content. Participants can acquire the ability to solve the questions in graduate school entrance examination.

●Prerequisite Subjects
Calculus I; Calculus II; or Consent of Instructor

●Course Topics
This is a companion course for the Statistical Physics II lecture course. Participants are expected to solve problems relating to the lecture course content in the following order: (1) The fundamental relation, Geometric relations of partial derivatives, Third law of thermodynamics. (2) Mathematical structure of thermodynamics, Fundamental relation and equation of state, Mixing pf distinguishable and indistinguishable particles. (3) Maximum work theorem, The Legendre transformed representations and the extremum principle. (4) Maxwell's relations, Statistical mechanics of isolated systems, High dimensionality effects, Central limit theorem. (5) Entropy of the classical ideal gas using the microcanonical ensamble, Applications of the binomial distribution and Poisson distribution. (6) Canonical partition function, Statistical mechanics of small systems, Entropy and disorder. (7) Canonical partition function and error in classical counting, Classical limit, Classical equipartition theorem. Participants are also expected to present their solutions on the whiteboard during the tutorial. Students will also submit tutorial assignments, which are set by the Statistical Physics II lecturer.

●Textbook
(1) Callen, Herbert, Thermodynamics and an Introduction to Thermostatistics, 2nd Ed., Wiley. (2) Reif, F., Fundamentals of Statistical and Thermal Physics, McGraw-Hill, 1965.

●Additional Reading
(1) Hill, T., An Introduction to Statistical Thermodynamics, Dover, 1986. (Excellent introduction to Statistical Mechanics at Year 3 level. Alternative textbook. Highly recommended. Cheap to buy.) (2) Kittel, C., Elementary Statistical Physics, Dover, 2004. (Highly recommended. Cheap to buy.) (3) Kubo R., Statistical Mechanics, North Holland, 1965. (More of a second course on Stat Mech, but contains many examples and worked solutions.) (4) Huang, K., Statistical Mechanics, Wiley. (Advanced reference.) (5) Kittel, C. and Kroemer, H., Thermal Physics, W.H. Freeman. (Try as alternative.) (6) Landau, L.D. and Lifshitz, E.M., Statistical Physics, Part I, by E.M. Lifshitz and L.P. Pitaevskii, Pergamon Press. (A classic book: thorough, advanced treatment.)

●Grade Assessment
Evaluated by total score: weekly assignments, attendance, class participation, and weekly oral presentation of solutions. (Weighting to be advised.) A score more than 60/100 is qualified.

●Notes
Students enrolled in Statistical Physics II are strongly advised to take this tutorial course.

●Contacting Faculty
During tutorials or by appointment.

Applied Physics Tutorial II b (1.0credits) (応用物理学演習２ｂ)

Course Type	Basic Specialized Courses	
Class Format	Exercise	
Course Name	Fundamental and Applied Physics	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	Masaaki Araidai Assistant Professor	Ai YAMAKAGE Assistant Professor

●Course Purpose
To master various concepts introduced in Quantum Mechanics II lecture course by solving a number of problems relating to the lecture course content. Participants can acquire the ability to solve the questions in graduate school entrance examination.

●Prerequisite Subjects
Quantum Mechanics 1 or Consent of Instructor. Students must have passed Quantum Mechanics 1 to take Quantum Mechanics 2 and Physics Tutorial 3b.

●Course Topics
This is a companion course for the Quantum Mechanics II lecture course. Participants are expected to solve problems relating to the lecture course content in the following order: (1) Symmetry properties of Newton's 2nd law, Meaning and examples of "Fictitious force", Introduction to Poisson Blackets. (2) Hamiltonian mechanics, Symmetry and conservation law, Canonical transformations, Revision of basic linear algebra. (3) Mathematical tools of quantum mechanics. (4) Applications of the postulates of quantum mechanics to simple problems. (5) Simple harmonic oscillator, Issue with quantization. (6) The space-time propagator revisited, The Uncertainty principle, The density operator. (7) Identical particles, Tensor product spaces, Entanglement.   Participants are also expected to present their solutions on the whiteboard during the tutorial. Students will also submit tutorial assignments, which are set by the Quantum Mechanics II lecturer.

●Textbook
(1) Shankar, R., 1994, Principles of Quantum Mechanics, 2nd ed., Kluwer Academic/Plenum. (2) Susskind, L. and Friedman, A., 2014, Quantum Mechanics: The Theoretical Minimum, Basic Books. Alternative, simple treatment of a subset of topics.

●Additional Reading
(1) Cohen-Tannoudji, C., Diu, B., Laloe, F., Quantum Mechanics, Wiley, 1991. Chapters 2 and 3 are required in the lectures. (2) Merzbacher, E., Quantum Mechanics, 3rd Ed., Wiley, 1998. (3) Gottfried, K. and Yan, T.-M., 2004, Quantum Mechanics: Fundamentals, Springer. (Advanced reference.)

●Grade Assessment
Evaluated by total score: weekly assignments, attendance, class participation, and weekly oral presentation of solutions. (Weighting to be advised.) A score more than 60/100 is qualified.

●Notes
Students enrolled in Quantum Mechanics II are strongly advised to take this tutorial course.

●Contacting Faculty
During tutorials or by appointment.

Computer Software I (2.0credits) (計算機ソフトウェア１)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	1 Autumn Semester	1 Autumn Semester	1 Autumn Semester
Elective/Compulsory	Compulsory Elective	Compulsory	Compulsory
Lecturer	EijiroTAKEUCHI Associate Professor	Hiraku okada Associate Professor	

●Course Purpose

The purpose of this course is to study basic computer literacy skills and basic computer programming techniques for solving various problems in the C language through exercises.

●Prerequisite Subjects

Basic mathematics

●Course Topics

1. Basic computer literacy skills - Writing and sending e-mails - UNIX command line interface2. Basics of the C language - Data types and variables - Control structures (Selection, loop, etc.) - Functions - Standard C library functions (Input/Output, Math, etc.) - Fundamental data structures (Scalars, arrays, etc.)3. Problem Solving by Programming

●Textbook

K.N. King: "C Programming: A Modern Approach, 2nd Edition", W. W. Norton & Company, 2008 (ISBN: 978-0393979503)

●Additional Reading

Some references will be announced in the lecture.

●Grade Assessment

Grades will be based on weekly reports, class attendance, and several project reports. Students must obtain a score of 60 or higher to pass the course. Grades: S: 100-90, A: 89-80, B: 79-70, C: 69-60, F: 59-0.

●Notes

Reports should be submitted after each lesson.

●Contacting Faculty

Students can communicate with their lecturer and TA during lecture hours or via email (cs1-20@katayama.nuee.nagoya-u.ac.jp).

Computer Software II (2.0credits) (計算機ソフトウェア２)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
Elective/Compulsory	Compulsory	Elective	Compulsory
Lecturer	Part-time Faculty		

●Course Purpose
Building on the knowledge gained in Computer Software 1, aim of Computer Software 2 is that students acquire advanced programming skills through C-programming exercises.
Advanced programming includes functions, arrays, string operations, structures, I/O, pointers, complex data structures, and large-scale programming. Students will acquire the skills to create practical large-scale programs utilizing several advanced programming tools.

●Prerequisite Subjects
Computer Software 1

●Course Topics
1. Review of Computer Software 1
2. Pointers
3. Pointers and Arrays
4. Strings
5. Input/Output
6. Writing Large Programs
7. Structures, Unions and Enumerations
8. Advanced Uses of Pointers
9. The Preprocessor, Declarations
10. Programming project I
11. Programming project II
12. Programming project III
13. Programming project IV
14. Programming project V
15. Programming project VI

Homework is assigned in the lecture.

●Textbook
K N King. C Programming: A Modern Approach. 2nd ed.

●Additional Reading
Some books will be introduced in the lecture.

●Grade Assessment
Programming skills are evaluated by homework assignments and programming projects.
Homework assignments : 50%
Programming projects : 50%
Students must obtain a score of 60 or higher out of 100 to pass the course.

●Notes
Based on the knowledge gained in Computer Software 1.

●Contacting Faculty
Students are encouraged to ask questions during and after lectures.
Faculty members can also be contacted at their offices, as well as by phone or email.

Applied Physics Tutorial III a (1.0credits) (応用物理学演習３ａ)

Course Type	Basic Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This is a companion course for the Quantum Mechanics I lecture course.Quantum mechanics governs the microscopic aspects of nature and is more fundamental than classical mechanics which is an approximate effective theory describing the macroscopic aspects of nature. This course aims to develop in students a solid understanding and basic knowledge of quantum mechanics, which is absolutely necessary in various fields of modern physics.

●Prerequisite Subjects

Fundamentals of Chemistry I and II, Fundamentals of Physics I to IV, Calculus I and II, Linear Algebra I and II.

●Course Topics

Participants are expected to prepare problems relating to the lecture course content and present their solutions on the whiteboard during the tutorial.Course Topics1 From Classical to Quantum Mechanics (Ch. 1)2 Wave Packets and the Schrodinger Equation (Ch. 2)3 The Quantum Mechanical Postulates (Ch. 3)4 The Particle in the Box 1 (Ch. 4)5 The Particle in the Box 2 (Ch. 5)6 Commuting and Non-commuting Operators and the Uncertainty Principle (Ch. 6)7 Harmonic Oscillator: Classical and Quantum Mechanical 1 (Ch. 7)8 Harmonic Oscillator: Classical and Quantum Mechanical 2 (Ch. 7)9 The Vibrational and Rotational Spectroscopy of Diatomic Molecules 1 (Ch. 8)10 The Vibrational and Rotational Spectroscopy of Diatomic Molecules 2 (Ch. 8)11 The Hydrogen Atom (Ch. 9)

●Textbook

T. Engel: Quantum Chemistry and Spectroscopy, 3rd Ed. (International edition), Pearson, 2014

●Additional Reading

Sakurai, J. J., Napolitano, Jim J., Modern Quantum Mechanics (2nd Ed.), Addison-Wesley, 2010.

●Grade Assessment

Fortnightly assignments; class participation; fortnightly oral presentation of solutions. (Weighting to be advised.)To pass, students must earn at least 60 points out of 100.

●Notes

Fundamentals of Chemistry I and II, Fundamentals of Physics I to IV, Calculus I and II, Linear Algebra I and II, or permission of the instructorStudents enrolled in Quantum Mechanics I are strongly advised to take this tutorial course.

●Contacting Faculty

During tutorials or by appointment.

Physical Chemistry I (2.0credits) (物理化学１)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	2 Autumn Semester	2 Autumn Semester
Elective/Compulsory	Compulsory	Elective
Lecturer	Peter BUTKO Designated Professor	

●Course Purpose
The purpose of this course is to learn what physical chemistry is all about and to grasp important principles and facts about physical chemistry. The course begins with perfect gas law, proceeds to thermodynamics, and finishes with applications of thermodynamics to simple mixtures.

●Prerequisite Subjects
Fundamentals of Chemistry I and II

●Course Topics
1 The Properties of Gases 1 (Ch. 1)
2 The Properties of Gases 2 (Ch. 1)
3 The First Law 1 (Ch. 2)
4 The First Law 2 (Ch. 2)
5 Pre-exam Review & EXAM 1 (Chs. 1 & 2)
6 The Second and Third Laws 1 (Ch. 3)
7 The Second and Third Laws 2 (Ch. 3)
8 Physical Transformations of Pure Substances (Ch. 4)
9 Simple Mixtures 1 (Ch. 5)
10 Simple Mixtures 2 (Ch. 5)
11 Pre-exam Review & EXAM 2 (Chs. 3 5)
12 Chemical Equilibrium 1 (Ch. 6)
13 Chemical Equilibrium 2 (Ch. 6)
14 Pre-final Review
15 FINAL EXAM (Ch. 1 6)

It is desirable to read a textbook or reference materials before a class

●Textbook
P. Atkins and J. de Paula: Atkins' Physical Chemistry, 11th Ed., Oxford University Press, 2018

●Additional Reading
Instructions will be given as necessary in class

●Grade Assessment
Two exams: 100 points each, final exam (comprehensive): 200, homework: 50. TOTAL: 450.
The "Absent" grade is reserved for students that withdraw by the 6th lecture period. After that day, a letter grade
will be awarded based on grades earned from all assignments during the semester.

●Notes
Fundamentals of Chemistry I and II

●Contacting Faculty
E-mail: pbutko@chem.nagoya-u.ac.jp

Mechanics of Continuous Media (2.0credits) (連続体物理学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Atsutomo NAKAMURA Associate Professor; Katsunori YOSHIMATSU Associate Professor

●Course Purpose

The purpose of this course is to gain an understanding of the basic idea underlying macroscopic view of the mechanics of continuous media. Course objectives include the followings;
(1) understanding basic concepts underlying the mechanics of continuous media
(2) the acquisition of calculus skills
(3) understanding the idea of the macroscopic view.

●Prerequisite Subjects

calculus, linear algebra, vector analysis, Fourier analysis, differential equations, fundamentals of physics

●Course Topics

1. Mechanics of elastic bodies
 1.1 Elastic constants
 1.2 Elastic deformation
 1.3 Plastic deformation
 1.4 The effect of environments on elastic bodies

2. Fluid Mechanics
 2.1 kinetics and conservation laws
 2.2 vorticity dynamics
 2.3 laminar flow
 2.4 boundary layers
 2.5 dimensional analysis

Review after each lecture.

●Textbook

not specified

●Additional Reading

Tritton, Physical Fluid Dynamics 2nd ed., Oxford Science Publications.
Suggestions are given during the lectures.

●Grade Assessment

Evaluated by the final examination and reports.
To pass, students must earn at least 60 points out of 100.
Students will pass, if they can solve basic/typical problems in this course.

Course withdrawal: Any student who does not participate in the final exam will receive the grade ``Absent''.

●Notes

No condition is required.

●Contacting Faculty

Question time:
[Fluid dynamics] after each lecture. Email: yoshimatsu@nagoya-u.jp
[Solid dynamics] after each lecture. Email: anaka@nagoya-u.jp

Applied Physics Tutorial III b (1.0credits) (応用物理学演習３ｂ)

Course Type	Basic Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This is a companion course for the Electricity and Magnetism lecture course.
This course is a solid introduction to electrostatics and magnetostatics. Maxwell’s Equations are derived.

By the end of the course, students will have gained an intuitive as well as quantitative understanding of the basic physical principles of electromagnetism, as well as familiarity -- and perhaps mastery -- of some of the fundamental mathematical methods required to solve problems in physics, engineering and applied mathematics.

This course has dual pedagogical aims: 1) to convey physical principles; 2) to improve students’ technical ability – i.e. ability to express physical intuition in mathematical terms and ability to solve problems.

●Prerequisite Subjects

Calculus I&II; Mathematical Physics II.

●Course Topics

Participants are expected to prepare solutions to problems relating to the lecture course content, which are handed out by the EM1 lecturer, and present their solutions on the whiteboard during the tutorial.

Course outline.

1. Revision of vector calculus, curvilinear coordinates, Dirac Delta Function.

2. Electrostatics. Coulomb's Law. Continuous Charge Distributions. Divergence and Curl of Electrostatic Fields. Field Lines, Flux, and Gauss's Law. Electric Potential. Poisson's Equation and Laplace's Equation. The Potential of a Localized Charge Distribution.

3. Work and Energy in Electrostatics. Conductors. Induced Charges. Surface Charge and the Force on a Conductor. The Method of Images: point charge near a conducting plane or sphere, grounded or insulated. Separation of Variables.

4. Electric Fields in Matter. Polarization. Dielectrics. The Electric Displacement. Linear Dielectrics.

5. Magnetostatics. The Lorentz Force Law. The Biot-Savart Law. The Divergence and Curl of B. Applications of Ampere's Law. Magnetic Vector Potential A. Gauge transformations.

6. Magnetic Fields in Matter. Magnetization. Diamagnetism, Paramagnetism, Ferromagnetism. The Auxiliary Field H. Magnetic Susceptibility and Permeability.

7. Introduction to Electrodynamics. Electromotive Force. Electromagnetic Induction. Faraday's Law. Energy in Magnetic Fields. Maxwell's Equations. Magnetic levitation.

●Textbook

Griffiths, D.L., 2012, Introduction to Electrodynamics, 4th ed., Prentice Hall.

●Additional Reading

1. Leighton, R.B. & Feynman, R.P., Feynman Lectures on Physics (Volume 2), Pearson. (Highly recommended alternative reading.)

2. Jackson, J.D., "Classical Electrodynamics", Wiley, 3rd Ed.

●Grade Assessment

Fortnightly assignments; class participation; fortnightly oral presentation of solutions. (Weighting to be advised.)

To pass, students must earn at least 60 points out of 100.

●Notes

Students enrolled in Electricity and Magnetism are strongly advised to take this tutorial course.

●Contacting Faculty

During tutorials or by appointment.

Biophysics (2.0credits) (生物物理学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	2 Spring Semester	2 Spring Semester
Elective/Compulsory	Elective	Compulsory Elective
Lecturer	TAMA Florence Muriel Professor	

●Course Purpose
To understand the basics of biophysics, in which biological phenomena are described in terms of physics language

●Prerequisite Subjects
biophysics

●Course Topics
The course will cover structure of biomolecules (proteins, nucleic acids, membranes) before introducing biophysical techniques (experimental and computational) to characterize function/dynamics/folding of these biomolecules.It is desirable to read a textbook or reference materials before a class

●Textbook
There is no designated textbook, but lecture materials will be handed out.

●Additional Reading
Instructions will be given as necessary in class

●Grade Assessment
The final grade will be based on a mid-term exam, student presentations, assignments and attendanceClass attendance is required. Absentee must give a valid reason. A student will be regarded as ABSENT if he/she is absent from lecture more than 3 times or he/she is absent without valid reason from the mid term exam and student presentation.

●Notes
There are no prerequisites

●Contacting Faculty
By email: florence.tama@nagoya-u.jp

Astrophysics (2.0credits) (宇宙物理学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Elective
Lecturer	TsutomuTAKEUCHI Associate Professor

●Course Purpose
To understand the hierarchy of the universe and the evolution of the universe based on classical mechanics, thermodynamics, statistical physics, electromagnetism, atomic physics, nuclear physics, relativity, and quantum mechanics.

●Prerequisite Subjects
Basic physics (mechanics, electrodynamics)

●Course Topics
Course Contents1. Hierarchy of the Universe2. Basic Astrophysical Concepts3. Our Solar System: Sun and Planets4. Stars and Interstellar Medium5. Planet formation6. Exoplanets7. Star formation8. The Milky Way Galaxy9. Galaxies in the Universe 10. The evolution of galaxies11. Cluster of galaxies and the large-scale structure12. Cosmic microwave background radiation and Big Bang13. Big Bang Nucleosynthesis and beyond14. The history and fate of the UniverseIt is desirable to read a textbook or reference

●Textbook
Material will be distributed during the courses.

●Additional Reading
Not specified. Some suggested readings will be introduced during the lectures.

●Grade Assessment
Based on reports on the subjects introduced in the lecture.

●Notes
Preferably some courses in basic physics (classical mechanics, electromagnetism, etc.)

●Contacting Faculty
TAKEUCHI TsutomuE-mail: E-mail: takeuchi.tsutomu@g.mbox.nagoya-u.ac.jp

Fluid Mechanics and Tutorial (2.5credits) (流体力学及び演習)

Course Type	Specialized Courses
Class Format	Lecture and Exercise
Course Name	Fundamental and Applied Physics
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	HOSSAIN Akter Designated Lecturer

●Course Purpose

The purpose of this course is to understand the fundamental characteristics of fluid motions applied to many areas of fluid mechanics and learn the physical laws governing them.
Students will:
(1) understand the properties, basic principles, and concepts of fluids.
(2) learn about the basic equations derived from above, i.e. continuity equation, motion equation, and energy equation, and be able to use them in calculations, and
(3) comprehend the aspects and properties of fluids conceptually utilizing the engineering observations of practical examples.

●Prerequisite Subjects

Calculus
Thermodynamics

●Course Topics

1. Properties of Fluid
2. Flow around bodies
3. Thermodynamics of fluid
4. Basic equations of fluid mechanics

Students will solve problems under faculty guidance.

Remarks: To obtain an excellent grade of this course, you have to prepare yourself properly by allocating enough time (i.e., it is your own duty/responsibility) for the assignment and final examination outside the course hours using the printed handouts of the lecture materials.

●Textbook

Printed handouts will be provided.

●Additional Reading

Fluid Mechanics; Robert A. Granger; Dover Publications (1995)

●Grade Assessment

Grades will be based on class participation, assignments and a final examination.

30% for attendance
30% for assignments
40% for final examination

●Notes

The whole lecture schedules/plans (including the date of the assignment/report, and the date of the final examination and so on) will be announced at the first class of each semester. The contents of the lecture, based on the course topics, will be provided in every lecture. However, the items as stated above are subject to change with prior notice during the semester.

●Contacting Faculty

Students can ask questions at any time during classes.

Questoins during off-class hours can be asked at the lecturer's room (Engineering Building No.3 North Wing, Room 223 (3125) or via e-mail: akter.hossain@mae.nagoya-u.ac.jp

Quantum Mechanics II (2.0credits) (量子力学２)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	John A. WOJDYLO Designated Professor

●Course Purpose

This 2nd course in quantum mechanics is the first half of a full-year course. The goal is to enable students to attain a solid grasp of basic concepts. Underlying the teaching approach is the philosophy that in order to learn well, learners must make it a habit to produce many simple calculations: in this way the mathematical language becomes second nature and students learn not to be overwhelmed by mathematical symbols, and to discern the simple physical principles expressed by them: students learn to express with ease their physical intuition using mathematical language. This approach also instills critical thinking, as students make it a habit to verify statements for themselves and not just believe everything they are told.The course consists of the equivalent of 15 lectures of examinable material, based on Shankar Chapters 1-10, which constitutes a standard one semester Year 3 topic coverage. In addition, a number of additional sessions will be offered to explain new concepts step by step or to explore quantum phenomena that are easily within reach of the core material -- somewhat like seminars for interest. The intention is to help students grasp the abstract content in the textbook, much of which strikingly contradicts classical intuition; and to see the amazing quantum reality. Alternatively, students who wish to just pass the unit may choose to work through the two books by Susskind, which cover the same topics (except for identical particles) in a far more elementary way, and submit a reasonable number of solved problems. The books by Susskind are written for people who have not previously learned physics. In this way, non-physics majors such as Biology students can learn concepts at the forefront of physics, such as the path integral, which is useful for computational treatments of the protein-folding problem, opening the possibility of their entry into physics labs such as the computational biology lab in the Department of Physics. Lectures are usually recorded and most of them are available on Youtube (private channel).seehttps://syllabus.sci.nagoya-u.ac.jp/detail/20190680430/

●Prerequisite Subjects

Quantum Mechanics 1 or Consent of Instructor.• Students must have passed Quantum Mechanics 1 to take Quantum Mechanics 2.

●Course Topics

Shankar Chapters 1-10; or Susskind1 and Susskind2. Some topics are more fully explored in tutorials.Lecture 1. [1] Symmetries and Conservation Laws. What is a state in classical mechanics? How do states evolve? State space, phase space. Why do trajectories never intersect? Newtonian mechanics. Formulation in terms of energy. The Lagrangian. Principle of Least Action. Euler-Lagrange equations. Cyclic coordinates and conserved quantities. (Susskind1)Lecture 2. [1] Symmetries and Conservation Laws cont'd. We seek a better way to characterize the connection between symmetries and conservation laws. Poisson brackets. Continuous symmetries. Generators of infinitesimal transformations. Angular momentum is the generator of infinitesimal rotations. Linear momentum is the generator of infinitesimal translations. The Hamiltonian is the generator of infinitesimal time translations. The PB of the Hamiltonian with the generator determines a conservation law if G generates a transformation that leaves the total energy invariant. (Susskind1)Lecture 3. [0.75] Canonical Transformations: transformations of phase space coordinates (not necessarily infinitesimal) that leave "the physics" unchanged. They map trajectories (i.e. a solution of the equations of motion) into physically equivalent (e.g. rotated) trajectories. (Shankar, Goldstein) NONEXAMINABLE: passive and active transformations. (Shankar, Goldstein)Optional Lecture 3B. A closer look at: canonical transformations; generators of infinitesimal canonical transformations; symmetry and conservation laws; classical Liouville's Theorem. Phase space is like a flowing incompressible fluid. The flow is a symmetry transformation generated by the Hamiltonian. (Goldstein Ch 8 and 9.)Lecture 4. [1] Mathematical Tools of QM: A First Look. What kind of mathematics do we need to describe QM experiments? (Based on Susskind2.)Optional Lecture 4B Mathematical Tools of QM. Introduction. Discrete basis, continuous basis. Orthonormality relations, closure relations. (Cohen-Tannoudji, Chapter 2)Lecture 5 [1] Mathematical Tools of QM. Dirac notation: ket, bra. Dual space. Discrete basis, continuous basis. Orthonormality relations, closure relations. (Same as last lecture, but in Dirac notation.) (Cohen-Tannoudji, Chapter 2)Lecture 6. [1] Mathematical Tools of QM. Change of basis using Dirac notation: discrete/continuous basis. Matrix elements of operators. Psi in r basis, p basis: change of basis here is a Fourier transform. Eigenvalue equations and observables. Degenerate, non-degenerate eigenvalues. Orthogonality of eigenspaces belonging to different eigenvalues. Hermitian operators have real eigenvalues. The concept of "observable": e.g., the projection operator. (Cohen-Tannoudji, Chapter 2)Lecture 6B. [1] Mathematical Tools of QM. Simultaneous diagonalization of two Hermitian operators: non-degenerate case; degenerate case. Block diagonal matrix. Functions of operators: differentiation, integration. Two useful, easy theorems. (Cohen-Tannoudji, Chapter 2; Shankar)Lecture 7. [0.5] Mathematical Introduction. Some operators in infinite dimensions: X and K operator matrix elements in X and K bases. Commutation operator [X,K]. Hermiticity in infinite dimensions: necessary and sufficient conditions. (Domain of unbounded operators.) NONEXAMINABLE: Meaning of diagonalization of Hermitian operators: normal modes/stationary states. Example: two masses on three springs in one dimension. Example: string clamped at both ends. (Shankar p. 46-54, 57-73.)Lecture 7B [1] Postulates of Quantum Mechanics (in-depth reprisal of Lecture 4). Quantum state. Reduction (collapse) of the wave packet; role of the projection operator; probability of results of measurement. [Time evolution of a system. (Susskind2 4.12, 4.13)] Quantization rules. Compatible, incompatible observables and the commutator operator. Imprecise measurements. (Cohen-Tannoudji p.213-225; 231-236; 263-266)seehttps://syllabus.sci.nagoya-u.ac.jp/detail/20190680430/It is desirable to read a textbook or reference

●Textbook

1. Shankar, R., 1994, Principles of Quantum Mechanics, 2nd ed., Kluwer Academic/Plenum.2. Susskind, L. and Hrabovsky, G., 2013, The Theoretical Minimum [Classical Mechanics], Basic Books.3. Susskind, L. and Friedman, A., 2014, Quantum Mechanics: The Theoretical Minimum, Basic Books.4. Cohen-Tannoudji, C., Diu, B., Laloe, F., Quantum Mechanics, Wiley, 1991. Chapters 2 and 3 are required in the lectures. They complement, and at times supersede, the treatment in Shankar.

●Additional Reading

1. Goldstein, H., Classical Mechanics, 2nd Edition.2. Feynman, R.P., Leighton, R.B., Sands, M., 2011, Feynman Lectures on Physics (Volume 3), Basic Books. (Highly recommended introductory book on quantum mechanics.) 3. Merzbacher, E., Quantum Mechanics, 3rd Ed., Wiley, 1998. (A great teacher of QM.)4. Gottfried, K. and Yan, T.-M., 2004, Quantum Mechanics: Fundamentals, Springer. (Advanced reference. Excellent treatment of identical particles and PEP.)5. Kreyszig, E., 1989, Introductory Functional Analysis with Applications, Wiley Classics. (Clear introduction to infinite dimensional Hilbert space, inner product spaces, spectral theory of linear operators, self-adjoint linear operators, etc. Read this - particularly the latter chapters on unbounded operators - if you want to clear up some mathematical concepts encountered in Shankar.)

●Grade Assessment

Attendance: 5%; Weekly quizzes or other written assessment: 30%; Mid-semester exam: 32.5%; Final Exam: 32.5%

●Notes

Quantum Mechanics 1 or Consent of Instructor.• Students must have passed Quantum Mechanics 1 to take Quantum Mechanics 2.

●Contacting Faculty

john.wojdylo@s.phys.nagoya-u.ac.jp

Applied Physics Laboratory II (1.5credits) (応用物理学実験２)

Course Type	Specialized Courses
Class Format	Experiment
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose
This course introduces basic and essential experiments in applied physics, which are related to each research laboratory in the department. Students will acquire basic experimental techniques and analytical methods for applied physics.
The goal is i) to acquire a series of basic skills of scientific measurement, ii) advenced methods to analyze experimental data, and iii) skills to summarize the result to a laboratory report and present it.

●Prerequisite Subjects
Applied Physics Laboratory I

●Course Topics
Applied Physics Laboratory II and Applied Physics Laboratory III are offered subsequently over the course of one year. Following the orientation, students will be divided in groups of 3-7 students and conduct experiments at each laboratory. Assistant professors will offer tutorials for each experiment.
1.X-ray diffraction
2.Interference of light, Luminescence of semiconductor
3.Measurements of thermal expansion of solid materials
: Effects of lattice vibration and magnetic phase transition on thermal expansion
4.Metallurgical physics, Magnetic properties
5.Reflection high energy electron diffraction
6.Electrons as particles and waves/ Diffraction and imaging of photons
7.Characterization of electrical properties of semiconductor materials
8.Growth and fundamental characterization of magnetic thin films
9.Excess free energy of grain boundaries
10.Synthesis and characterization of cuprate superconductors
11.Magnetic resonance, conductivity measurements
12.Crystal structure and electronic state analyses of solid materials by diffraction and spectroscopy techniques

Students need to prepare a laboratory report for each of the laboratory assignments and submit it on time.

●Textbook
Textbooks for each experiment will be distributed at each research laboratory and each experiment will be guided by an assistant professor. Students should bring their own experimental notebook, graph paper, and a scientific calculator to the laboratory.

●Additional Reading
Books for reference will be introduced as necessary.

●Grade Assessment
Grades will be based on the attendance on the experiments and all the reports for each experiment. Students must obtain a score of 60/100 or higher to pass the course. Delayed submission of reports will affect the applicable grades.

●Notes

No conditions for taking this class is imposed.

●Contacting Faculty

Contact faculty staffs of each laboratory assignment.

Applied Physics Seminar (2.0credits) (応用物理学セミナー)

Course Type	Specialized Courses
Class Format	Seminar
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

The purpose of this class is to deepen the understanding of the role of fundamental physics in modern technology by discussing various subjects in the field of applied physics.

●Prerequisite Subjects

Mathematics, Analytical Mechanics, Electricity and Magnetism, Quantum Mechanics, Statistical Physics

●Course Topics

This is a seminar course; a student takes the course offered in a laboratory. Each student is expected to make presentations about various subjects in the field of applied physics. Appropriate reference books or papers will be designated during the course. Understanding should be further strengethened through discussions among participants following the presentations.

●Textbook

Books will be introduced as necessary.

●Additional Reading

Books for reference will be introduced as necessary.

●Grade Assessment

Presentation, activity in the discussion and report. Students must obtain a score of 60/100 or higher to pass the course.

●Notes

Students need to satisfy a condition of the credits hours for assigning the laboratory. For the detailed information, please contact faculty staffs.

●Contacting Faculty

Contact faculty staffs of the laboratory.

Optics (2.0credits) (物理光学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Hideo KISHIDA Professor

●Course Purpose

To understand the properties of light and various interactions between light and matters, and acquire basic knowledge about optical devices to control the light.

Goals:
1. To become able to explain the reflection, refraction and propagation of light on basis of knowledge of electromagnetic waves.
2. To become able to explain the interaction between light and matters.

●Prerequisite Subjects

Electricity and magnetism, mathematics

●Course Topics

1. Electromagnetic waves and polarization of light
Maxwell equations, Fresnel's equations, polarized lights, electrooptical effects

2. Spectroscopy and optical properties of materials
Dispersion and absorption, spontaneous emission and stimulated emission

In addition to the lectures, the assignments are given.

●Textbook

Not designated.

●Additional Reading

G. R. Fowles, Introduction to Modern Optics (Second Edition), Dover,
ISBN: 0-486-65957-7

●Grade Assessment

Grades are determined based on examination and assignments. The criterion of pass is to reach the basic level of the goals.

●Notes

No conditions are required.

●Contacting Faculty

Students are encouraged to make questions after the lecture.

Condensed Matter Physics I (2.0credits) (物性物理学１)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Bernard GELLOZ Designated Associate Professor

●Course Purpose
The goal of this course is to learn about the crystal structures of solids and their determination by diffraction techniques.First the different types of atomic bonding are introduced. Then some mechanical properties are discussed, then crystal structures are presented based on a symmetry analysis. The reciprocal lattice is described in relation to thediffraction phenomenon. The relations of the reciprocal lattice with Fourier analysis and plane waves are discussed.Some practical aspects of X-ray diffraction are presented for the cubic crystal system. The amplitude and intensities of diffraction peaks are discussed, introducing structure and form factors.

●Prerequisite Subjects
Fundamental Physics

●Course Topics
1. Bonding in Solids2. Crystal Structure and Periodic Structure3. Bravais Lattices; Famous Crystal Structures4. Typical Symmetry Elements5. Real Space and Reciprocal Space6. X-ray diffraction; Bragg Condition; Laue Function7. Brillouin zone8. Crystal Structure Factor9. Structure Determination by X-ray diffraction10. Elastic properties of solids and elastic strainsIt is desirable to read a textbook or reference

●Textbook
Introduction to Solid State Physics (IE), 8th EditionKittel, Charles/ McEuen, Paul.John Wiley & Sons Inc 2005.(12,015)

●Additional Reading
Ashcroft&Mermin: Solid State Physics (Brooks/Cole) Price: ~$60P. Hofmann: Solid State Physics, an introduction (Wiley-VCH) Price: ~$40

●Grade Assessment
Gradeswill be based on homework, a midterm examination and a final examination

●Notes
There are no prerequisites

●Contacting Faculty

Chemical Physics (2.0credits) (化学物理学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	3 Autumn Semester	3 Autumn Semester
Elective/Compulsory	Elective	Compulsory Elective
Lecturer	YukoOKAMOTO Professor	

●Course Purpose
The purpose of this course is to learn about the statistical thermodynamics which can describe the behaviors of molecules in physical, chemical, and biological systems.

●Prerequisite Subjects
Biophysics, Statistical Physics I

●Course Topics
1. Mathematical Tools2. Extremum Principles3. Heat, Work, and Energy4. Entropy and the Boltzmann Law5. Thermodynamic Driving Forces6. The Logic of Thermodynamics7. Laboratory Conditions and Free Energy8. Maxwell's Relations and Mixtures9. The Boltzmann Distribution Law10. The Statistical Mechanics of Simple Gases and Solids11. Temperature and Heat Capacity12. Chemical EquilibriaIt is desirable to read a textbook or reference materials before a class

●Textbook
K.A. Dill and S. Bromberg, "Molecular Driving Forces" 2nd ed. (Garland Science).

●Additional Reading
F. Reif, "Fundamentals of Statistical and Thermal Physics" (McGraw-Hill).

●Grade Assessment
Attendance: 10 %, Homework Sets: 20 %, Exams: 70 %The “Absent” grade is reserved for students who withdraw by the day that is specified by the University. After thatday, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes
There are no prerequisites

●Contacting Faculty
Email: okamoto@tb.phys.nagoya-u.ac.jp

Computational Chemistry (2.0credits) (計算化学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	3 Autumn Semester	3 Autumn Semester
Elective/Compulsory	Elective	Compulsory
Lecturer	YANAI Takeshi Professor	

●Course Purpose
Computers and computing technologies are becoming increasingly important as a tool to facilitate complex work and expand ones' abilities for carrying out chemical studies. In this class, attendees will learn basics of programming for effectively using computer and write programs in Python language for numerical analysis, chemical calculations, etc.

●Prerequisite Subjects
quantum chemistry

●Course Topics
1. Python programming Tutorial
2. Numpy Tutorial
3. Graph and plotting: Matplotlib
4. Quantum chemistry calculations
5. Potential energy curves
6. Geometry optimization
7. Plotting of molecular orbitals
8. Problem sets

It is desirable to read a textbook or reference materials before a class

●Textbook
There is no designated textbook, but lecture materials will be handed out.

●Additional Reading
Python tutorial: https://docs.python.org/2/tutorial/
Numpy quick tutorial: https://docs.scipy.org/doc/numpy/user/quickstart.html
Matplotlib quick tutorial: https://matplotlib.org/tutorials/introductory/pyplot.html
Hartree-Fock theory:
http://vergil.chemistry.gatech.edu/courses/chem6485/pdf/Hartree-Fock-Intro.pdf
Scikit-learn tutorials: http://scikit-learn.org/stable/tutorial/index.html

●Grade Assessment
Attendance and report on programming
"Absent": if 10% of 90min class is absent in class room. "Fail": if final report is not handed in.

●Notes
There are no prerequisites

●Contacting Faculty
yanait@chem.nagoya-u.ac.jp

Scientific Measurements (2.0credits) (計測工学)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	3 Autumn Semester	3 Autumn Semester	3 Autumn Semester
Elective/Compulsory	Elective	Elective	Compulsory
Lecturer	Tsuyoshi UCHIYAMA Associate Professor	Kiichi NIITSU Associate Professor	

●Course Purpose

In generally science and measurement are closely correlated and product technologies have been developed with developing measurement technologies. The purpose of the course is to develop an understanding of the fundamentals of measurement systems, including sensor devices and signal processing circuits.The goal is to be able to do the following by learning this lecture.1. Understand the principle of measurement and device configuration. 2. Selection of sensor devices required for measurement. 3. Signal processing required for measurement

●Prerequisite Subjects

Electronics, Electrical circuit

●Course Topics

1. Outline (systematization of measurement etc.)2. Operation principle of sensing elements3Signal detection and conversion4Signal processingPlease read the designated part of the textbook before each class.

●Textbook

Distribute printed maters by the lecturer.

●Additional Reading

We will introduce appropriate books as the lecture progresses.

●Grade Assessment

Report Acceptance criteria are to be able to properly explain the measurement and the device configuration required for the measurement, and to correctly understand basic concepts and terms related to signal processing required for the measurement.Credits will be awarded to those students who score 60 or more. Grades are as follows:S:100-90, A:89-80, B:79-70, C:69-60, F:59-0.

●Notes

No course requirements.

●Contacting Faculty

Questions are accepted after each lecture at the class room or in the office by appointment. To T. Uchiyama, call ext.3617 or e-mail to tutiyama@nuee.nagoya-u.ac.jp To K. Niitsu, call ext.2794 or e-mail to niitsu@nuee.nagoya-u.ac.jp

Fluid Mechanics (2.0credits) (流体力学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory Elective
Lecturer	HOSSAIN Akter Designated Lecturer

●Course Purpose
The purpose of this course is to understand the fundamental characteristics of fluid motions applied to many areas of fluid mechanics and learn the physical laws governing them.
Students will:
(1) understand the properties, basic principles, and concepts of fluids.
(2) learn about the basic equations derived from above, i.e. continuity equation, motion equation, and energy equation, and be able to use them in calculations, and
(3) comprehend the aspects and properties of fluids conceptually utilizing the
engineering observations of practical examples.

●Prerequisite Subjects
Calculus, Thermodynamics, Elementary fluid mechanics/dynamics

●Course Topics
1.Vortex, circulation and integral of motion equation
2.Flow of incompressible non-viscous fluid
3.Flow of viscous fluid
4.Flow of compressible fluid

Remarks: To obtain an excellent grade of this course, you have to prepare yourself properly by allocating enough time (i.e., it is your own duty/responsibility) for the assignment and final examination outside the course hours using the printed handouts of the lecture materials.

●Textbook
Printed handouts will be provided.

●Additional Reading
Fluid Mechanics; Robert A. Granger; Dover Publications (1995)

●Grade Assessment
Grades will be based on class participation, assignments and a final examination.

30% for attendance
30% for assignments
40% for final examination

●Notes
The whole lecture schedules/plans (including the date of the assignment/report, and the date of the final examination and so on) will be announced at the first class of each semester. The contents of the lecture, based on the course topics, will be provided in every lecture. However, the items as stated above are subject to change with prior notice during the semester.

●Contacting Faculty
Students can ask questions at any time during classes.
Questoins during off-class hours can be asked at the lecturer's room (Engineering Building No.3 North Wing, Room 223 (3125) or via e-mail: akter.hossain@mae.nagoya-u.ac.jp

Statistical Physics III (2.0credits) (統計物理学３)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	John A. WOJDYLO Designated Professor

●Course Purpose

his is an intermediate-advanced course in statistical mechanics and thermodynamics. Students learn quantum statistics of ideal gases, introductory statistical mechanics of systems of interacting particles and introductory theory of phase transitions and critical phenomena, and some modern theory such as the scaling hypothesis and an introduction to renormalization group theory (the spatial renormalization group). If time permits, we will also cover Callen Ch 14 on irreversible thermodynamics, including the Onsager Reciprocity, with an application to thermoelectricity: the Seebeck Effect, Peltier Effect and Thomson Effect. In this unit applications are considered in condensed matter physics, solid state physics, cosmology, chemistry, materials science and biology. For chemistry majors, this course together with Statistical Physics II provides a powerful boost to your skills set and opens many doors.

●Prerequisite Subjects

Statistical Physics II; or Consent of InstructorPhysics Tutorial IV. It is strongly advised that students concurrently register for Physics Tutorial IV.

●Course Topics

Some topics are covered in tutorial assignments. The precise order and content of the lectures might vary slightly.Lecture 1. Quantum statistical mechanics. Quantum states of a single particle. Reflecting boundary conditions, periodic boundary conditions. Density of states in 3, 2 and 1 dimensions, for linear and quadratic dispersion relations. Turning sums into integrals. Example: EM radiation.Lecture 2. The quantum distribution functions: Fermi-Dirac, Bose-Einstein distributions. Photon statistics: Planck distribution. Systems with varying number of particles: the Grand Canonical ensemble and partition function. Occupation number formalism: mean occupation number and dispersion. Role of the chemical potential.Lecture 3. Dispersion of fluctuations. The classical/quantum crossover. Mean energy in the classical limit. Maxwell-Boltzmann statistics; resolution of the “Gibbs Paradox”.Lecture 4. Examples. Vapour pressure of a solid. Diatomic molecules. Black body radiation: Stefan-Boltzmann Law; Wien’s Displacement Law; radiation pressure; Grand Canonical partition function and probability of a many-body state at temperature T. Example: adsorption of a gas onto a 2D surface. Lecture 5. The ideal Fermi fluid: conduction electrons in metals. Specific heat and ground state energy in 3D, 2D, 1D. Sommerfeld expansion.Lecture 6. The ideal Bose fluid: Bose-Einstein condensation in 3D. What about in 2D or 1D? Critical temperature. Mean energy, specific heat. The possibility of BEC in a photon gas. Breakdown of the Grand Canonical description.Lecture 7. Systems of interacting particles (1). The Debye Model of solids. Normal modes. Specific heat.Lecture 8. Systems of interacting particles (2). Weakly nonideal gases: virial expansion. Derivations of the Van der Waals equation of state for a weakly non-ideal gas, as well as for a fluid using a self-consistent mean field approach. Lecture 9. Stability of thermodynamic systems. Concavity/convexity of thermodynamic potentials. Le Chatelier’s Principle. First Order phase transitions, features of the free energy. Discontinuity in the entropy: latent heat. Slope of the coexistence curves: Clausius-Clapeyron Equation.Lecture 10. Van der Waals fluid: unstable isotherms, physical isotherm, Maxwell equal-area rule. Multicomponent systems: Gibbs phase rule. Why does the phase diagram of water not have more than three phases coexisting at the same point?Lecture 11. The Fluctuation-Dissipation Theorem. Response functions and correlations. Quantitative explanation of critical opalescence.Lecture 12. Examples of phase transitions (order-disorder transition, which is a structural phase transition). Why do fluctuations get out of control near the critical point? Alben’s Model. Landau Theory: classical theory in the critical region. Order parameter and the critical exponents ,,,; their classical values. Lecture 13. Magnetic systems: ferromagnetism and models for it. Ising model. Mean field theory treatment of the 1D Ising chain. Critical exponents.Lecture 14. Ising model continued. No phase transition in the 1D Ising chain: proof by a simple argument; and by solving the model exactly – no phase transition but at any finite field, magnetisation gets saturated if temperature is low enough. Ising model in 2D (just mention): critical exponents, behaviour of the specific heat. Spin correlation function: exact calculation for the 1D Ising chain. Phase diagram of ferromagnetic systems. Cause of the breakdown of the classical theory (qualitative).Lecture 15. Breakdown of the classical theory and advent of the modern theory. Derivation of an inequality involving critical exponents – but all experiments suggest equality holds. Scaling hypothesis: ad hoc argument. Justification of the scaling hypothesis using Kadanoff's block spins. Spatial renormalization group theory and sample calculation for the 1D Ising chain.It is desirable to read a textbook or reference materials before a class

●Textbook

1. Callen, Herbert, Thermodynamics and an Introduction to Thermostatistics, 2nd Ed., Wiley. (The Japanese translation has fewer misprints.)2. Reif, F., Fundamentals of Statistical and Thermal Physics, McGraw-Hill, 1965.3. Plischke, M. & Bergersen, B., Equilibrium Statistical Mechanics, 3rd Ed., World Scientific, 2006.

●Additional Reading

1. Kittel, C., Elementary Statistical Physics, Dover, 2004. (Highly recommended. Cheap to buy.)2. Kittel, C. and Kroemer, H., Thermal Physics, W.H. Freeman. (Try as alternative.)3. Blundell, S. and Blundell, K., Concepts in Thermal Physics, 2nd Ed., Oxford University Press, 2010. (Elementary explanations. Many copies available in the library.)4. Cardy, J., Scaling and renormalization in statistical physics, Cambridge Univ. Press, 1996.5. Huang, K., Statistical Mechanics, Wiley. (Advanced.)

●Grade Assessment

Attendance: 5%; Weekly quizzes or other written assessment: 25%; Mid-term exam: 35%; Final Exam: 35% The "Absent" grade is reserved for students who withdraw by the official May deadline. After that day, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes

Statistical Physics II; or Consent of Instructor

●Contacting Faculty

john.wojdylo@s.phys.nagoya-u.ac.jp

Applied Physics Tutorial IV a (1.0credits) (応用物理学演習４ａ)

Course Type	Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This is a companion course for the Statistical Physics III lecture course. At the end of this course, students will have mastered basic aspects of quantum statistics of ideal gases, statistical mechanics of systems of interacting particles, and the theory of phase transitions and critical phenomena, including modern topics such as the scaling hypothesis and spatial renormalization group theory.

●Prerequisite Subjects

Statistical Physics II; or Consent of Instructor

●Course Topics

Participants are expected to solve problems relating to the lecture course content, and present their solutions on the whiteboard during the tutorial. Students will also submit tutorial assignments, which are set by the Statistical Physics III lecturer.1. Some revision of Statistical Physics II. Grand Canonical Partition Function. Quantum distribution functions: Bose distribution, Fermi distribution, Planck distribution. Examples.2. The ideal Fermi fluid: conduction electrons in metals. Specific heat and ground state energy in 3D, 2D, 1D. Sommerfeld expansion.3. The ideal Bose fluid: Bose-Einstein condensation in 3D. 4. The Debye Model of solids.5. Weakly nonideal gases: virial expansion. Derivations of the Van der Waals equation of state.6. Stability of thermodynamic systems. Le Chatelier’s Principle. First Order phase transitions. Discontinuity in the entropy: latent heat. Clausius-Clapeyron Equation.7. Van der Waals fluid: unstable isotherms, physical isotherm, Maxwell equal-area rule. Multicomponent systems: Gibbs phase rule.8. The Fluctuation-Dissipation Theorem. Response functions and correlations. Quantitative explanation of critical opalescence.9. Landau Theory: classical theory in the critical region. Order parameter and the critical exponents ,,,; their classical values.10. Magnetic systems: ferromagnetism and models for it. Ising model. Mean field theory treatment of the 1D Ising chain. Critical exponents.11. Exact solution of 1D Ising model. 12. Breakdown of the classical theory and advent of the modern theory. Widom Scaling Law. Rushbrooke Scaling Law. Scaling hypothesis: ad hoc argument. Justification of the scaling hypothesis using Kadanoff's block spins. Spatial renormalization group theory and sample calculation for the 1D Ising chain.

●Textbook

1. Callen, Herbert, Thermodynamics and an Introduction to Thermostatistics, 2nd Ed., Wiley. 2. Reif, F., Fundamentals of Statistical and Thermal Physics, McGraw-Hill, 1965.3. Plischke, M. & Bergersen, B., Equilibrium Statistical Mechanics, 3rd Ed., World Scientific, 2006.

●Additional Reading

1. Hill, T., An Introduction to Statistical Thermodynamics, Dover, 1986. (Excellent introduction to Statistical Mechanics at Year 3 level. Alternative textbook. Highly recommended. Cheap to buy.) 2. Kittel, C., Elementary Statistical Physics, Dover, 2004. (Highly recommended. Cheap to buy.)3. Kubo R., Statistical Mechanics, North Holland, 1965. (More of a second course on Stat Mech, but contains many examples and worked solutions.)4. Huang, K., Statistical Mechanics, Wiley. (Advanced reference.)5. Kittel, C. and Kroemer, H., Thermal Physics, W.H. Freeman. (Try as alternative.)6. Landau, L.D. and Lifshitz, E.M., Statistical Physics, Part I, by E.M. Lifshitz and L.P. Pitaevskii, Pergamon Press. (A classic book: thorough, advanced treatment.)

●Grade Assessment

Fortnightly assignments; class participation; fortnightly oral presentation of solutions. (Weighting to be advised.)To pass, students must earn at least 60 points out of 100.

●Notes

Students enrolled in Statistical Physics III are strongly advised to take this tutorial course.

●Contacting Faculty

Students enrolled in Statistical Physics III are strongly advised to take this tutorial course.

Applied Physics Tutorial IV b (1.0credits) (応用物理学演習４ｂ)

Course Type	Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This is a companion course for the Quantum Mechanics III lecture course, which is the second half of a full-year course. Building on Quantum Mechanics 2, students will learn quantum mechanics at an advanced undergraduate level. The course will build physical intuition of Nature on the quantum scale while improving students' ability to express physical intuition in mathematical terms and to solve problems. Students will be adequately prepared with regards to their knowledge of quantum mechanics to undertake further studies in S-lab, E-lab, H-lab, R-lab, TB-lab and other, experimental labs in both the Department of Physics and Department of Applied Physics at Nagoya University. A knowledge of the principles is essential for students interested in experimental physics and theoretical physics. Students from other disciplines, such as chemistry, can also benefit from the deep treatment of quantum phenomena.

●Prerequisite Subjects

Quantum Mechanics II; or Consent of Instructor

●Course Topics

Participants are expected to solve problems relating to the lecture course content, and present their solutions on the whiteboard during the tutorial. Students will also submit tutorial assignments, which are set by the Quantum Mechanics III lecturer.This tutorial course covers the same topics as the Quantum Mechanics III lecture course: Shankar Chapters 11-19 (some parts omitted).1. Symmetry and Conservation laws in Quantum Mechanics. Translational invariance and its consequences. Active and passive views. Transformation of operators. Infinitesimal translations. Finite translations. Correspondence with translations in Euclidean space. Time translation invariance; parity invariance; resultant conservation laws.2. Rotational invariance and its consequences. Rotations in Euclidean space do not commute: derivation of commutation relations between generators of infinitesimal rotations in Euclidean space. Consequence: commutation relations in Hilbert space (and quantum mechanics). Conservation of angular momentum.3. Rotational invariance and angular momentum. Irreducible representations. Solution of rotationally invariant problems. The free particle in spherical coordinates.4. The (spinless) hydrogen atom in coordinate basis; quantization condition. Comparison with experiment; reasons for deviations. Fine structure corrections; hyperfine structure corrections. 5. Spin. Mathematical representation of spin: spinors and their generalization. Kinematics: properties of the Pauli spin matrices. Spin dynamics. 6. Addition of angular momentum. Clebsch-Gordon coefficients.7. Spherical tensor operators and selection rules: Wigner-Eckart Theorem. Selection rules. Irreducible tensor operators. Explanation of "accidental" degeneracies.8. The Variational Method and WKB Approximation.9. Time-independent Perturbation Theory (non-degenerate and degenerate). Dipole selection rule. Example: Stark effect. 10. Time-dependent Perturbation Theory. Transition rate. Sudden perturbation. Adiabatic perturbation. Periodic perturbation. Fermi's Golden Rule. 11. Gauge transformations, invariance of QM under gauge transformation. 12. Photoelectric effect in the hydrogen ground state. 13. Elementary introduction to scattering theory. Born approximation. Method of partial waves. Higher orders in perturbation theory. Schroedinger picture, Interaction picture, Heisenberg picture.

●Textbook

Shankar, R., 1994, Principles of Quantum Mechanics, 2nd ed., Kluwer Academic/Plenum.

●Additional Reading

1. Merzbacher, E., Quantum Mechanics, 3rd Ed., Wiley, 1998.2. Sakurai, J. J., Napolitano, Jim J., Modern Quantum Mechanics (2nd Ed.), Addison-Wesley, 2010.3. Cohen-Tannoudji, C., Diu, B., Laloe, F., Quantum Mechanics, Wiley, 1991. 4. Gottfried, K. and Yan, T.-M., 2004, Quantum Mechanics: Fundamentals, Springer. (Advanced reference.)

●Grade Assessment

Fortnightly assignments; class participation; fortnightly oral presentation of solutions. (Weighting to be advised.)To pass, students must earn at least 60 points out of 100.

●Notes

Students enrolled in Quantum Mechanics III are strongly advised to take this tutorial course.

●Contacting Faculty

Students enrolled in Quantum Mechanics III are strongly advised to take this tutorial course.

Applied Physics Laboratory III (1.5credits) (応用物理学実験３)

Course Type	Specialized Courses
Class Format	Experiment
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This course introduces basic and essential experiments in applied physics, which are related to each research laboratory in the department. Students will acquire basic experimental techniques and analytical methods for applied physics.
The goal is i) to acquire a series of basic skills of scientific measurement, ii) advenced methods to analyze experimental data, and iii) skills to summarize the result to a laboratory report and present it.

●Prerequisite Subjects

Applied Physics Laboratory I

●Course Topics

Applied Physics Laboratory II and Applied Physics Laboratory III are offered subsequently over the course of one year. Following the orientation, students will be divided in groups of 3-7 students and conduct experiments at each laboratory. Assistant professors will offer tutorials for each experiment.
1.X-ray diffraction
2.Interference of light, Luminescence of semiconductor
3.Measurements of thermal expansion of solid materials
: Effects of lattice vibration and magnetic phase transition on thermal expansion
4.Metallurgical physics, Magnetic properties
5.Reflection high energy electron diffraction
6.Electrons as particles and waves/ Diffraction and imaging of photons
7.Characterization of electrical properties of semiconductor materials
8.Growth and fundamental characterization of magnetic thin films
9.Excess free energy of grain boundaries
10.Synthesis and characterization of cuprate superconductors
11.Magnetic resonance, conductivity measurements
12.Crystal structure and electronic state analyses of solid materials by diffraction and spectroscopy techniques

Students need to prepare a laboratory report for each of the laboratory assignments and submit it on time.

●Textbook

Textbooks for each experiment will be distributed at each research laboratory, and each experiment will be guided by an assistant professor. Students should bring their own experimental notebook, graph paper, and a scientific calculator to the laboratory.

●Additional Reading

Books for reference will be introduced as necessary.

●Grade Assessment

Grades will be based on the attendance on the experiments and all the reports for each experiment. Students must obtain a score of 60/100 or higher to pass the course. Delayed submission of reports will affect the applicable grades.

●Notes

No conditions for taking this class is imposed.

●Contacting Faculty

Contact faculty staffs of each laboratory assignment.

Quantum Mechanics III (2.0credits) (量子力学3)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	John A. WOJDYLO Designated Professor

●Course Purpose

This course will be called Quantum Mechanics 3 after 2018.This unit is the second half of a full-year course. Building on Quantum Mechanics 2, students will learn quantum mechanics at an advanced undergraduate level. The course will build physical intuition of Hilbert space and Nature on the quantum scale while improving students' ability to express physical intuition in mathematical terms and to solve problems. Students will learn not to be overwhelmed by mathematical symbols, and to discern the simplicity of physical principles expressed by them.Topics include: Symmetry and conservation laws; theory of angular momentum (including addition of angular momentum); solution of rotationally invariant problems; the (spinless) hydrogen atom; Spherical tensor operators and selection rules: Wigner-Eckart Theorem; The Variational Method and WKB Approximation; Time-independent perturbation theory (non-degenerate and degenerate cases); Time-dependent perturbation theory; introduction to scattering theory.Students will be adequately prepared with regards to their knowledge of quantum mechanics to undertake further studies in S-lab, E-lab, H-lab, R-lab, TB-lab and other, experimental labs in both the Department of Physics and Department of Applied Physics at Nagoya University. A knowledge of the principles is essential for students interested in experimental physics and theoretical physics. Students from other disciplines, such as chemistry, can also benefit from the deep treatment of quantum phenomena.

●Prerequisite Subjects

Quantum Mechanics 2 or Consent of Instructor.• Students must have passed Quantum Mechanics 2 to take Quantum Mechanics 3.Physics Tutorial IV. It is strongly advised that students concurrently enroll in Physics Tutorial IV.

●Course Topics

Course Contents Shankar Chapts 11-19 (some parts omitted); parts of Cohen-Tannoudji et. al, Sakurai, Merzbacher, Gottfried. Some topics are covered in tutorials.Lecture 1. Translational invariance and its consequences. Active and passive views. Transformation of operators. Infinitesimal translations. Finite translations. Correspondence with translations in Euclidean space. Translational invariance defined. Consequence: a certain conservation law. Translational invariance in two dimensions: importance of commutation of generators.Lecture 2. Invariance and conservation laws cont'd. Time translation invariance; parity invariance; resultant conservation laws. Formal correspondence between generators of infinitesimal canonical transformations and generators of infinitesimal unitary transformations. Time-reversal symmetry and anti-linear operators: Wigner's Theorem. Lecture 3. Rotational invariance and its consequences. Rotations in Euclidean space do not commute: derivation of commutation relations between generators of infinitesimal rotations in Euclidean space. Consequence: commutation relations in Hilbert space (and quantum mechanics). Conservation of angular momentum.Lecture 4. Rotational invariance and angular momentum. Rotations in 2D: correspondence between those in Euclidean space and Hilbert space. Identifying the generator of infinitesimal rotations in Hilbert space. Active and passive views. Consistency checks: composition of translations and rotations in Hilbert space and Euclidean space. Lie algebra. The eigenvalue problem of L_z. Angular momentum in 3D and the eigenvalue problem of J^2 and J_z. Matrix representation: block diagonal forms and partitioning of Hilbert space.Lecture 5. Rotational invariance and angular momentum cont'd. Finite rotation operators. Irreducible representations. Orbital angular momentum eigenfunctions in the coordinate basis. Solution of rotationally invariant problems. The free particle in spherical coordinates.Lecture 6. Solution of rotationally invariant problems cont'd. Radial equation, reduced radial equation, boundary conditions. The (spinless) hydrogen atom in coordinate basis; quantization condition. Eigenfunctions. Also in momentum basis.Lecture 7. The (spinless) hydrogen atom cont'd. Cause of "unexpected" degeneracy. Comparison with experiment; reasons for deviations. Fine structure corrections; hyperfine structure corrections. Spin. Mathematical representation of spin: spinors and their generalization. Response of vector field (r) under infinitesimal rotation produces two kinds of generators of infinitesimal rotations, corresponding to orbital and intrinsic angular momentum operators. Kinematics: properties of the Pauli spin matrices. Spin dynamics. Classical magnetic moment suggests form of spin magnetic moment operator. Derivation of Bohr magneton in the Coulomb gauge. Time evolution of spinors. Lecture 8. Addition of angular momentum. Clebsch-Gordon coefficients.Lecture 9. Spherical tensor operators and selection rules: Wigner-Eckart Theorem. Irreducible tensor operators. Explanation of "accidental" degeneracies.Lecture 10. Addition of L and S. The Variational Method and WKB Approximation. Tunneling amplitudes; bound states.Lecture 11. Time-independent Perturbation Theory (non-degenerate case). 1st order and 2nd order energy corrections; 1st order correction to wave function. Dipole selection rule. Example: Stark effect. Lecture 12. Time-independent Perturbation Theory (degenerate case). Time-dependent Perturbation Theory. Transition rate. Sudden perturbation. Adiabatic perturbation. Lecture 13. Time-dependent Perturbation Theory cont'd. Periodic perturbation. Fermi's Golden Rule. Gauge transformations, invariance of QM under gauge transformation. Photoelectric effect in the hydrogen ground state. seehttps://syllabus.sci.nagoya-u.ac.jp/detail/20190680530/It is desirable to read a textbook or reference materials before a class

●Textbook

Shankar, R., 1994, Principles of Quantum Mechanics, 2nd ed., Kluwer Academic/Plenum.

●Additional Reading

1. Cohen-Tannoudji, C., Diu, B., Laloe, F., Quantum Mechanics, Wiley, 1991. (This book complements, and at times supersedes, the treatment in Shankar.)2. Merzbacher, E., Quantum Mechanics, 3rd Ed., Wiley, 1998.(Merzbacher was one of the best teachers of quantum mechanics.)3. Sakurai, J. J., Napolitano, Jim J., Modern Quantum Mechanics (2nd Ed.), Addison-Wesley, 2010.(This book complements, and at times supersedes, the treatment in Shankar.)4. Messiah, A., Quantum Mechanics (2 Volumes), Dover, 2015.(Highly recommended, classic alternative reading. Cheap to buy.)5. Gottfried, K. and Yan, T.-M., 2004, Quantum Mechanics: Fundamentals, Springer. (Most of this book is too hard for undergraduates but several sections are at the right level and very clear. Consult this book as an authoritative reference.)

●Grade Assessment

Attendance: 5%; Weekly quizzes or other written assessment: 30%; Mid-term exam: 32.5%; Final Exam: 32.5%The "Absent" grade is reserved for students who withdraw by the official deadline in May. After that day, a letter grade will be awarded based on marks earned from all assessment during the semester.

●Notes

Quantum Mechanics 2 or Consent of Instructor.• Students must have passed Quantum Mechanics 2 to take Quantum Mechanics 3.

●Contacting Faculty

john.wojdylo@s.phys.nagoya-u.ac.jp

Condensed Matter Physics II (2.0credits) (物性物理学２)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Bernard GELLOZ Designated Associate Professor

●Course Purpose

The goal of this course is to learn about the fundamental theories related to the behavior of electrons and atoms in solids and about the mechanism of some of the most important properties solids exhibits, including electrical, thermal, and mechanical properties.

●Prerequisite Subjects

There are no prerequisites

●Course Topics

1. Lattice vibrations; Phonons2. Heat capacity of solids - Classical theory3. Heat capacity of solids - Einstein model and Debye model4. Thermal conductivity of solids5. Introduction to electron theory of metals; Drude model6. Free electron model: quantum approach; Fermi sphere7. Concept of energy bands8. Fermi-Dirac distribution function9. Electronic specific heat10. Semiconductors11. Dielectric properties of solidsIt is desirable to read a textbook or reference materials before a class

●Textbook

Introduction to Solid State Physics (IE), 8th EditionKittel, Charles/ McEuen, PaulJohn Wiley & Sons Inc. 2005(12,015)

●Additional Reading

Ashcroft&Mermin: Solid State Physics (Brooks/Cole) Price: ~$60P. Hofmann: Solid State Physics, an introduction (Wiley-VCH) Price: ~$40

●Grade Assessment

Grades will be based on homework, a midterm examination and a final examination.

●Notes

There are no prerequisites

●Contacting Faculty

Applied Physics Tutorial V a (1.0credits) (応用物理学演習５ａ)

Course Type	Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	4 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

The aim of this tutorial is to help students acquire an understanding of mathematics for physics and applied skills in physical science and engineering. At the end of the course, participants are expected to solve the problems of mathematics that are used in physics and explain the solution.

●Prerequisite Subjects

Mathematics I and Tutorial, Mathematics II and Tutorial

●Course Topics

Solve typical exercises on Mathematical Methods that are used in physics. Reports should be submitted for other exercises. The tutorial covers following topics.1. Second order linear differential equations2. Series solutions of differential equations3. Complex Functions4. Complex Integral

●Textbook

Exercises will be provided in the classes.

●Additional Reading

Mathematical methods in the physical sciences by M.L. BoasMathematical methods for physicists by G.B. Arfken, H.J. Weber, and F.E. Harris

●Grade Assessment

Evaluated by answers and reports. Students can earn credits if they can correctly deal with basic problems in mathematical methods. If students can handle more difficult problems, they will get better grades.

●Notes

There is no requirement for course registration.

●Contacting Faculty

During exercise or at the laboratory office.

Applied Physics Tutorial V b (1.0credits) (応用物理学演習５ｂ)

Course Type	Specialized Courses
Class Format	Exercise
Course Name	Fundamental and Applied Physics
Starts 1	4 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

This is a companion course to Electromagnetics III, and offers practical exercises for mastering the concepts introduced in the lecture courses.The purpose of this course is to obtain the following skills:1. To solve problems of electromagnetics.2. To explain the solutions for problems.

●Prerequisite Subjects

Electricity and Magnetism, Mathematics I and Tutorial, Mathematics II and Tutorial

●Course Topics

Exercises for solving various problems related to the lecture courses of Electromagnetics III. The problems for following topics will be given:1. Maxwell's equations2. Electromagnetic wave3. Electromagnetic potential4. Moving chargesThe problems which cannot be solved will be treated as assignments. Students should review related topics in Electromagnetics III before the exercises.

●Textbook

The textbooks for the lectures Electromagnetics I, II, and III.

●Additional Reading

Additional materials will be introduced according to the specific targets of the exercise problems.

●Grade Assessment

Weekly assignments; attendance; class participation. (Weighting to be advised.)Whether a student obtained the required skills or not is evaluated by scores for the assignments. Record more than 60/100 is qualified.

●Notes

Students taking the lecture course Electromagnetics III should also take this tutorial class.

●Contacting Faculty

Questions are welcome after each exercise. It is better for students to contact the lecturer by telephone or e-mail beforehand.

Condensed Matter Physics III (2.0credits) (物性物理学３)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	4 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	TANIYAMA Tomoyasu Professor

●Course Purpose
The purpose of this course is to show the students cutting-edge research in condensed-matter physics and to motivate them to study this rich and fertile research area. This course also aims at reviewing fundamental physics such as electromagnetism, statistical physics, and quantum mechanics through various aspects of advanced materials.Each lecture is covered by a different professor, and the students can grasp various research frontiers throughout thecourse.

●Prerequisite Subjects
Condensed-Matter Physics I, II

●Course Topics
Each lecture is given by the individual instructor shown in parentheses.Please note that the contents below are just tentative. The final program will be distributed at the first lecture.1. Introduction to Condensed Matter Physics III (Prof. Tomoyasu Taniyama)2. Theoretical Physics of Foods, Gels, Glasses, and All That (Prof. Kunimasa Miyazaki)3. Physics in Quasicrystals (Prof. Kazuhiko Deguchi)4. Magnetism and Superconductivity in Strongly Correlated Electron System (Prof. Kazuhiko Deguchi)5. Superconductivity in Strongly Correlated Systems (Prof. Hiroshi Kontani)6. Massless Dirac Fermions in Condensed Matter Physics (Prof. Akito Kobayashi)7. Nematicity and Orbital Order (Prof. Seiichiro Onari)8. Condensed Matter Studies by NMR (Prof. Yoshiaki Kobayashi)9. Magnetism and Superconductivity (Prof. Masayuki Itoh)10. Topological quantum spin liquids (Prof. Yasuhiro Shimizu)11. Superfluidity (Prof. Taku Matsushita)12. Introduction to Thermoelectricity (Prof. Ichiro Terasaki)13. Fundamentals and Applications of Ferroelectricity (Prof. Hiroki Taniguchi)14. The Uses of Spin : From Fundamentals to Spintronics (Prof. Hiroshi Kohno)15. Nano-scale Magnetism (Prof. Tomoyasu Taniyama)It is desirable to read a textbook or reference materials before a class

●Textbook
There is no designated textbook, but lecture materials will be handed out.

●Additional Reading
Instructions will be given as necessary in class

●Grade Assessment
Attendance and ReportsThe “Absent” grade is reserved for students who withdraw by the deadline designated by the University. Classattendance is required and absentee must have a valid reason. Unless withdrawal is declared, the “Fail” grade willbe given, when a student misses lectures more than three times. It will be also given, when he or she missessubmission of reports more than three times.

●Notes
None, but the concepts learned in condensed-matter physics I and II may be treated as preknowledge.

●Contacting Faculty
Prof. Tomoyasu TaniyamaE-mail: taniyama.tomo@nagoya-u.jp

Particle Physics (2.0credits) (素粒子物理学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Fundamental and Applied Physics
Starts 1	3 Autumn Semester
Elective/Compulsory	Elective
Lecturer	Masayasu HARADA Professor

●Course Purpose
To learn basic concepts of particle physics through the introduction to recent developments of research activities.

●Prerequisite Subjects
Fundamental Physics

●Course Topics
[Oct. 7] Hadron physics (Masayasu Harada)[Oct. 21] Quark Gluon Plasma (Chiho Nonaka)[Oct. 28] The standard model in particle physics (Junji Hisano)[Nov. 11] Physics beyond the standard model (Kazuhiro Tobe)[Nov. 18] Gravity (Yasusada Nambu)[Nov. 25] Models of grand unified theories (Nobuhiro Maekawa)[Nov. 28 (Thursday)] Superstring theory (Tadakatsu Sakai)[Dec. 2] Motion of Objects in Curved Spacetimes (Chulmoon Yoo) [Dec. 9] Neutron physics (Hirohiko Shimizu)[Dec. 16] Tau Physics (Kenji Inami)[Dec. 23] B physics (Toru Iijima)[Jan. 20] Neutrino physics (Osamu Sato)[Jan. 27] LHC physics (Makoto Tomoto)[Feb. 3] Dark matter (Toshiyuki Nakano)

●Textbook
There is no designated textbook, but lecture materials will be handed out.

●Additional Reading
Instructions will be given as necessary in class

●Grade Assessment
Attendance and reportsClass attendance is required. Absentee must give a valid reason. A student will receive an “Absent” grade if he is absent from lecture more than 3 times

●Notes
There are no prerequisites

●Contacting Faculty
Contact via e-mail to harada.masayasu@nagoya-u.jp

Earth and Planetary Science (2.0credits) (地球惑星科学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Chemistry	Fundamental and Applied Physics
Starts 1	3 Autumn Semester	3 Autumn Semester
Elective/Compulsory	Elective	Elective
Lecturer	Marc HUMBLET A. Designated Associate Professor	

●Course Purpose

In this course students will learn about the characteristics of the planets and other components of our solar system (orbital parameters, atmospheric conditions, internal structure and composition, geomorphology, geological activity).We will use the knowledge of our own planet Earth as a reference to understand processes occurring elsewhere.During the past fifty years, various spacecrafts and exploration vehicles have been used to considerably expand our knowledge of the solar system and send back to Earth ever more detailed pictures of distant worlds. The course will review the different means of space exploration and use abundant data acquired by past and ongoing missions to illustrate the characteristics of the planets. A recurrent topic throughout the course will be the fascinating question of the existence of extraterrestrial life and its detection. We will also discuss the future of space exploration.

●Prerequisite Subjects

characteristics of the planets and other components of our solar system

●Course Topics

1. Introduction2. The Solar System3. Space Exploration4. The Earth-Moon System5. Mercury6. Venus7. Mars8. The asteroid belt9. Jupiter10. Saturn11. Uranus & Neptune12. Trans-Neptunian ObjectsIt is desirable to read a textbook or reference materials before a class

●Textbook

There is no designated textbook, but lecture materials will be handed out.

●Additional Reading

Instructions will be given as necessary in class

●Grade Assessment

Two quizzes: 20% (10% each)Two short reports: 20% (10% each)Oral presentation: 20%Written essay: 40%A student will be given an “Absent” grade if he or she submits a Course Withdrawal Request Form by the end ofNovember. This deadline does not apply to students who drop the class part-way through for an exceptional reason(e.g. illness, accident). A “Fail” grade is given to students who obtain a final score of less than 60%.

●Notes

There are no prerequisites

●Contacting Faculty

Phone: 052-789-3037 / E-mail: humblet.marc@f.mbox.nago ya-u.ac.jp

Graduation Research A (5.0credits) (卒業研究Ａ)

Course Type	Specialized Courses
Class Format	Experiment and Exercise
Course Name	Fundamental and Applied Physics
Starts 1	4 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose
The purpose of this course is to develop creativity and acquire a research-oriented mindset through the study of specialized subjects in applied physics.The goal is i) to understand their own research projects and design the research projects, ii) to find out how to solve the problems of their own research projects and conduct the research and iii) to present the results obtained by the research projects.

●Prerequisite Subjects
For assigning the laboratory students need to satisfy a condition of the credits hours , which is determined by the program. For the detailed information, please contact faculty staffs.

●Course Topics
Each student will be assigned to the laboratories with the students in the Japanese course, and perform theoretical, experimental, or computational researches under the guidance of professors.

●Textbook
Books will be introduced as necessary.

●Additional Reading
Books for reference will be introduced as necessary.

●Grade Assessment
Grades will be based on the graduation thesis and presentation. Students must obtain a score of 60/100 or higher to pass.

●Notes
Students need to satisfy a condition of the credits hours for assigning the laboratory. For the detailed information, please contact faculty staffs.

●Contacting Faculty
Contact faculty staffs of the laboratory.

Graduation Research B (5.0credits) (卒業研究Ｂ)

Course Type	Specialized Courses
Class Format	Experiment and Exercise
Course Name	Fundamental and Applied Physics
Starts 1	4 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Faculty of Fundamental and Applied Physics

●Course Purpose

The purpose of this course is to develop creativity and acquire a research-oriented mindset through the study of specialized subjects in applied physics.The goal is i) to understand their own research projects and design the research projects, ii) to find out how to solve the problems of their own research projects and conduct the research and iii) to present the results obtained by the research projects.

●Prerequisite Subjects

For assigning the laboratory students need to satisfy a condition of the credits hours , which is determined by the program. For the detailed information, please contact faculty staffs.

●Course Topics

Each student will be assigned to the laboratories with the students in the Japanese course, and perform theoretical, experimental, or computational researches under the guidance of professors.

●Textbook

Books will be introduced as necessary.

●Additional Reading

Books for reference will be introduced as necessary.

●Grade Assessment

Grades will be based on the graduation thesis and presentation.Students must obtain a score of 60/100 or higher to pass.

●Notes

Students need to satisfy a condition of the credits hours for assigning the laboratory. For the detailed information, please contact faculty staffs.

●Contacting Faculty

Contact faculty staffs of the laboratory.

Outline of Engineering III (2.0credits) (工学概論第３)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	3 Autumn Semester	4 Autumn Semester	4 Autumn Semester
	4 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	Emanuel LELEITO Lecturer	Gang ZENG Lecturer	Kiyohisa NISHIYAMA Lecturer

●Course Purpose

This course introduces the history, the current state and future prospects of R&D (research and development) in various sectors related to the field of engineering in Japan. This class consists of “omnibus-style” lectures, all provided in English.

What you will get tips in this lecture for:
Communication across different engineering fields
Communication across language barriers (English/Japanese)
Search skills for locating professional topics and information
Presentation skills

Reports and presentations, which require students to independently search necessary information, will be assigned in the lectures. The students should note that these reports are used for evaluation.

●Prerequisite Subjects

This lecture does not require any background subject. Fundamental knowledge will be clearly instructed.

●Course Topics

1. Science, Technology and Innovations in Embedded Computing Systems (Gang ZENG)
- This lecture gives an overview of the embedded computing systems related technologies in Japan. In particular, the latest innovations on the low-energy and automotive applications will be introduced.
- The students are asked to participate in group discussion to share their ideas and thoughts about energy conservation and future automobiles.
2. The innovative factors of technologies in Japan (Kiyohisa NISHIYAMA)
- This lecture provides the participants with the concept of 40 innovation principles. Some Japanese technologies are broken down into the combination of the principles as examples.
- The students each are asked to analyse a technology of interest found in Japan. The students will be able to grab the concepts of any technological innovations after completing this lecture.
3. Science, Technology and Innovation for Disaster Risk Reduction (Emanuel LELEITO)
- This lecture gives students an overview of the Scientific and Technology Innovations that have contributed to Japan’s leading role in Disaster Risk Reduction (DRR).
- DRR related discussions and presentation in class will help students exercise their creative thinking and problem solving skills.
  3.3 Current Problems and Future of Mass Production

●Textbook

Lecture materials will be distributed during at each lecture.

●Additional Reading

Lecture materials will be distributed during at each lecture.

●Grade Assessment
Credits will be awarded to those students who score over 60 out of 100, based on the evaluation on reports(60%) and final presentation(40%).

●Notes
The students are required to actively join group discussions, reports and presentations.

●Contacting Faculty
Questions are received during or after class time.

View of Advanced Electrical/ Electronic and Information Engineering (2.0credits) (電気電子情報先端工学概論)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	3 Autumn Semester	4 Autumn Semester	4 Autumn Semester
	4 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose
This course discusses the fundamentals of, and current topics in each field of the advanced electrical, electronic and information engineering, with an overview of the status of their researches and developments in Japan. Topics to be introduced are those related with energy, material and device, information and communication, multimedia and so on.
Students will be familiar with the most advanced technologies in the above subject matter.

●Prerequisite Subjects
Physics, Electromagnetics, Mathematics

●Course Topics
This course consists of two parts:
1. Six lectures in the classroom which will be given by faculty members.
2. Tours to three laboratories of companies and/or research organizations.

These six lectures are divided three pairs of lectures and each pair is on one of Electrical Engineering, Electronics, and Information and Communication Engineering. Each lecture covers from the fundamental to the cutting-edge topics of the research area of the faculty member responsible to it.
During three tours, students will visit laboratories on energy generation and novel materials.

Submission of a report after each lecture and tour is mandatory.

●Textbook
Some books will be introduced in the lecture.

●Additional Reading
Some books will be introduced in the lecture.

●Grade Assessment
Submission of a report after each lecture and tour is mandatory. A knowledge of lectured advanced technologies in electrical,electronic and information engineering is evaluated by the reports. The final score is determined based on scores of these reports.Students must obtain a score of 60 or higher out of 100 to pass the course.

●Notes
Although the time slots assigned to this course are 3rd period (13:00-14:30) and 4th period (14:45-16:15), the tours may take longer time and finish after 16:15.
Students must attend all lectures and join all tours. If there is a student who missed a tour without notice, it compromises the reputation of Nagoya university.

●Contacting Faculty
Students are encouraged to ask questions during and after lectures.
Faculty members can also be contacted at their offices, as well as by phone or email.

Introduction to Civil Engineering and Architecture (2.0credits) (環境土木・建築学概論)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Chemistry	Fundamental and Applied Physics	Automotive Engineering
	Automotive Engineering		
Starts 1	3 Autumn Semester	4 Autumn Semester	4 Autumn Semester
	4 Autumn Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective		
Lecturer	Associated Faculty	Associated Faculty	

●Course Purpose

The objectives of this course are (1) to establish scenarios for certain social infrastructure projects, and thereby introduce relevant civil engineering theories and construction technology, as well as conduct site-visits; (2) to survey, through technical site visits, various aspects of urban and architectural studies, including building material experiments, energy conservation, and the recent development of regional disaster mitigation activities. After completing this course, students will be able to:1. Understand civil engineering theories and construction technology2. Understand urban and architectural studies.

●Prerequisite Subjects

As the objective of this class is to understand fundamentals of civil engineering and architecture, no background class is assigned.

●Course Topics

Lecture and Site-visit 1: Preservation of Historical AreaLecture and Site-visit 2: Architecture and cultureLecture and Site-visit 3: Nagoya University Disaster Mitigation Research CanterLecture 4: Social infrastructure and civil engineering (1) Expressway Development in JapanLecture 5: Social infrastructure and civil engineering (2) Maintenance and Operation of ExpresswaySite-visit 6: Maintenance and Operation of ExpresswaySite-visit 7: Traffic Control Center of ExpresswayReports will be assigned in each lecture.

●Textbook

Directed as needed.

●Additional Reading

Directed as needed.

●Grade Assessment

Students will be evaluated on written reports. To pass, students must understand the fundamentals of civil engineering theories and construction technology, and urban and architectural studies.

●Notes

Not required

●Contacting Faculty

Coordinator: NAKAMURA Hideki (ext. 2771, nakamura@genv.nagoya-u.ac.jp)

Introduction to Chemical and Biological Industries (2.0credits) (化学・生物産業概論)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Fundamental and Applied Physics	Automotive Engineering	Automotive Engineering
Starts 1	4 Spring Semester	4 Spring Semester	4 Spring Semester
Elective/Compulsory	Elective	Elective	Elective
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

This course is provided to give a broad overview of activities in chemical and biological industries in Japan. The course is open to both Japanese and foreign students.
Students will understand R&D trend and current status of production activities in chemical and biological industries in Japan.

●Prerequisite Subjects

Not specified.

●Course Topics

This course introduces the state-of-the-art and the future of R&D and production activities of chemical and biological industries in Japan. Their relationships with the human society, how they are involved in the energy and environmental issues, their roles in international societies, etc. are also discussed. Researchers who have ample experience in working abroad are invited to give stimulating lectures in English.

1. R&D process in biotechnology companies
2. Materials design with considering environmental issues
3. Process engineering of Advanced Ceramics

Homework will be assigned.

●Textbook

Not specified. Handouts will be supplied if necessary.

●Additional Reading

Not specified. It will be introduced when necessary.

●Grade Assessment

Grading will be decided based on reports. Reports will be evaluated by the level of comprehension and ability of rational discussion on the subject.
Credits will be awarded to those students who scored 60 or more.
Grades are as follows: A+:100-90, A:89-80, B:79-70, C+:69-65, C-:65-60, F:59-0

●Notes

This course will be taught in English.
Both short stay foreign students and Japanese students will be accepted.

●Contacting Faculty

Ask to the lecturers in the class.