Syllabus 2017

Graduate School of Pharmaceutical Sciences
Tohoku University

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Subject	Advanced Pharmacology				
Course Numbering	Y MP PHA 5 51 J Y LP PHA 5 51 J	Categories	Elective		
Preferable Participants	MC 1st	Schedule	Monday 9:00-12:00	Credits	3
Instructor	Tetsuya Terasaki, Kohji Fukunaga, Atsushi Matsuzawa, Tohru Yamakuni, Masanori Tachikawa, Takuya Noguchi, Fumino Fujiyama				
Objectives and summary of class	In this course, students understand the importance of stress-responsive signaling as drug targets, the relationship of drug efficacy, drug metabolism, and pharmacokinetics with adverse events, the function and clinical significance of drug delivery system, the mechanisms of plasticity and functional regeneration in the brain and the significance of drug discovery research targeting such mechanisms, and the medical care using natural drugs and the importance of natural drugs as lead compounds of drug discovery.				
Goal of study	The purpose of this course is to help students understand and explain basic important points of chemical pharmacology and the importance of its application to drug discovery and clinical pharmacy.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Apr. 10	Atsushi Matsuzawa, Takuya Noguchi	Stress-responsive signaling as drug targets	Organisms are always exposed to various types of stress, such as oxygen radicals, ultraviolet rays, and pathogen infection, and therefore sense the stress and maintain homeostasis by appropriate responses to the stress through stress-responsive signaling. Disregulation of the signaling leads to various diseases. This lecture provides explanations of drug discovery research targeting stress-responsive signaling molecules.
2			Practice	The practice of drug discovery research targeting stress-responsive signaling molecules in various methods improves students' skill of discovery and development research of new drugs.
3	Apr. 17	Atsushi Matsuzawa, Takuya Noguchi	Drug discovery research based on molecular mechanisms of cell death and inflammation	In recent years, it has become clear that a reduced ability to induce cell death and excessive inflammation lead to various diseases. Therefore, signaling molecules involved in the induction of cell death and inflammatory responses are considered as attractive targets for drug discovery. This lecture provides explanations of drug discovery research based on molecular mechanisms of cell death and inflammation.
4			Practice	The practice of drug discovery research based on molecular mechanisms of cell death and inflammation in various methods improves students' skill of discovery and development research of new drugs.

5	Apr. 24	Kohji Fukunaga, Fumino Fujiyama	Drug development targeting for neuronal plasticity	Dysfunction of neural network and synaptic functions following neuronal death is progressing in the aging brain. Likewise, the abnormal morphological changes in neuronal dendritic spines are associated with mental disorders such as mental retardation and schizophrenia. The lecture focuses on the neuropsychiatry drug development to improve neuronal plasticity in the brain.
6			Practice	The students should learn the skill for drug development targeting for neuronal plasticity in neurodegenerative and mental disorders.
7	May 1	Kohji Fukunaga	Safety and harmful side effects of medicines	Although the preclinical studies in drug development promise the efficacy and safety of medicines, the patients are often suffering from the harmful side effects by medicine. The lecture focuses on the preclinical studies for pharmacokinetic toxicity and safety tests. The lecture also introduces the history and lessons from drug-induced sufferings.
8			Practice	The students should learn the problems for ignoring hazard information and policy for preventing drug-induced sufferings.
9	May 8	Tohru Yamakuni	1. Application of natural drugs to new drug discovery. 2. A novel brain protein that controls a neuronal terminal identity and its application to brain regeneration	A huge number of natural drugs have been employed as lead compounds with novel pharmacological mechaisms for drug development and as fundamental therapeutic drugs in modern medicine. In this lecture, students learn about the importance of natural drugs as lead compounds of drug discovery for fundamental treatment of Alzheimer's disease and the potential clinical benefits. Also, I provide a lecture on the brain protein that controls master transcriptional regulators as well as transmitter synthetic and transporter genes conferring a neuronal terminal identity and its application to drug discovery and brain regeneration.
10			Practice	The practice regarding drug discovery research employing the natural drugs and application of the neuronal identity-regulating factor improves the students' abilities to comprehend and explain the relevant studies.
11	May 15	Tetsuya Terasaki, Masanori Tachikawa	Pharmacokinetics for the drug development	Understanding of drug distribution and elimination based on pharmacokinetic (PK) is getting much more important for the drug development. We will introduce advanced pharmacokinetics and pharmacodynamics (PD).
12			Practice	To get deep understanding of advanced PK and PD, several practical examples will be demonstrated.

13	May 22	Tetsuya Terasaki, Masanori Tachikawa	Molecular mechanism of membrane transport	Membrane transport is one of the most important determinant factors regulating drug distribution and elimination. Together with receptor mediated transcytosis, role of the solute carrier (SLC) and the ATP-binding Cassette (ABC) transporters will be introduced.
14			Practice	To get deep understanding of the molecular mechanism of transporters, several case studies will be performed.
15	(Undecided)	Tetsuya Terasaki, Kohji Fukunaga, Atsushi Matsuzawa, Tohru Yamakuni, Masanori Tachikawa, Takuya Noguchi	Special lecture	The latest findings of chemical pharmacology are introduced. Students select interesting one among several special lectures.
16				
17			Practice	Students arrange the contents of the special lecture and deepen their understanding of it by reading of the related reviews and articles in order to make their knowledge more accurate. Furthermore, students improve their ability to write sentences by training to summarize the contents and their knowledge in a report.
18				
Record and evaluation method	Evaluation is performed comprehensively based on discussion, presentation, submitted report and so on, in the practice.			
Textbook/ Reference	Each instructor introduces reference books and scientific literature as required.			
Preparation and Review	Students are required to prepare and review for class according to the goal and contents of each class.			
Language Used in Course	Japanese			
In addition				

Subject	Advanced Molecular and Structural Analysis				
Course Numbering	Y MP PHA 5 11 J Y LP PHA 5 11 J	Categories	elective		
Preferable Participants	MC 1st	Schedule	Thursday 9:00-12:00	Credits	3
Instructor	Junichi Anzai, Tomoyuki Oe, Takakazu Nakabayashi, Shozo Furumoto, Shinji Kajimoto				
Objectives and summary of class	This course is designed to help students understand the research methodology which provides insights and understanding to biological functions of proteins, DNA, biopolymers, and ions on the basis of the principles of physical chemistry. Students will also understand how the methods of physical chemistry are applied to clarify the structures of biomolecules and to perform quantitative analyses of pharmaceutical products.				
Goal of study	Students will be familiar with the fundamentals of the following topics: ion and biomolecular sensors, electrochemical analyses of proteins, relationships between structural abnormalities of proteins and diseases, structural analyses using fluorescence spectroscopy, structures and functions of antibodies, biomolecular analyses using mass spectrometry, bio-imaging using radiation rays, bio-imaging using super-resolution microscopy techniques. Students will also improve their ability to read and understand the papers related to the topics and summarize them as a report.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	May 11	Junichi Anzai	Electrochemistry of proteins	This lecture provides the basic concept of protein electrochemistry and its applications to the evaluation of redox properties of proteins. An outline of bioelectronic devices is also discussed.
2			Excercises	Students will improve their ability to comprehension and expression of the basis of protein electrochemistry through excersises.
3	May 18	Junichi Anzai	Ion sensors and biosensors	This lecture provides the principle, preparation, measurements, and data analysis of ion sensors and biosensors.
4			Excercises	Students will improve their ability to comprehension and expression of the practical applications of ion sensors and biosensors through excersises.
5	May 25	Shinji Kajimoto	Super-resolution microscopy and its application to biology	This lecture provides the basic principle of super-resolution microscopy and its application to bio-imaging.
6			Exercises	Students will improve their ability to comprehension and expression of the basis of super-resolution microscopy throurh various excersises.

7	Jun. 1	Tomoyuki Oe	Mass spectrometry of bioactive low molecular weight compounds	This lecture focuses on how mass spectrometry can be used to qualify/quantify small molecules, such as drugs, lipids, steroids, etc. The typical ionization, mass separation, and scanning methods are introduced to understand each principle and characteristics. Students can learn the practical knowledge of mass spectrometric analysis for biomolecules with various examples.
8			Exercises	Students are asked to answer several related questions for deeper understanding.
9	Jun. 8	Tomoyuki Oe	Mass spectrometry of biomacromolecules	This lecture focuses on how mass spectrometry can be used to qualify/quantify macromolecules, especially proteins. The specific strategies in protein analysis are introduced in terms of ionization, mass separation, database search, etc. Students can learn recent strategy of protein analysis for identification, quantification, and screening of post-translational modifications including chemical modifications.
10			Exercises	Students are asked to answer several related questions for deeper understanding.
11	Jun. 15	Takakazu Nakabayashi	Fluorescence spectroscopy in biological research	This lecture provides the basic concepts of high sensitive detection of molecules, proteins, and intracellular environments using fluorescence spectroscopic techniques.
12			Exercises	Students will improve their ability to comprehension and expression of the basis of fluorescence and bioscience throurh various excersises.
13	Jun. 22	Shozo Furumoto	PET radiopharmaceuticals and diagnostic imaging	PET is a highly quantitative technology for analyzing pharmacokinetics in vivo by imaging with a radiolabeled compound. The utility of PET imaging is well known as a molecular imaging method which is applicable to human and useful for medical diagnosis and drug development. This class provides basic and state-of-the-art knowledge of PET probes and clinical diagnosis.
14			Exercises	Students will improve their ability to comprehension and expression of the basis of diagnostic imaging and related radiopharmaceuticals through various exercises.
15	unde cided	Junichi Anzai, Tomoyuki Oe, Takakazu Nakabayashi, Shozo Furumoto, Shinji Kajimoto	Special lecture for advanced course	Students select one of the lectures and learn about the latest topics in biomolecular analyses.
16				
17			Exercises	Students will deepen their understanding of the special lecture by reading the related reviews and papers. Students will also improve their writing ability by summarizing the contents and expressing their opinions of the special lecture as a report.
18				

Record and evaluation method	Evaluation is performed comprehensively based on attendance, submitted report, and a questions and answers session in exercises.
Textbook/ Reference	
Preparation and Review	
Language Used in Course	Japanese
In addition	

Subject	Advanced Applied Bio-pharmaceutical Sciences /Special Lecture in Pharmacy II*				
Course Numbering	Y MP PHA 5 62 J Y LP PHA 5 62 J Y PH PHA 7 12 J*	Categories	Elective/ Required*		
Preferable Participants	MC 1st /DC 1st*	Schedule	Thursday 18:00-19:30	Credits	3 /2*
Instructor	Noriyasu Hirasawa, Takayuki Doi, Hiroshi Satou, Takashi Dan, Kouji Ikeda, Kzuhiko Yanai, Naoko Matsui, Akira Inoue, Yukinari Kato, Hiroaki Yamaguchi, Masahiro Kikuya, Ryosuke Nakamura, Takuhiro Yamaguchi, Manabu Tashiro, Shozo Furumoto, Shiro Endo				
Objectives and summary of class	In this course, students will understand ethics, basic knowledge and technique that are required to carry out clinical research and clinical trial.				
Goal of study	Students understand the significance and the strategy of clinical study and trial in human.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Apr. 13	Hirasawa	Animal model and assessment of drug efficacy	To develop a new drug, the assessment of the efficacy in animal experimental model is important. In this lecture, you can learn application examples of various animal models and their limitation.
2	Apr. 20	Doi	Organic Chemistry & Medicinal Chemistry	Organic compounds are often included in pharmaceutical products. This lecture features basic organic chemistry from the point of view of medicinal chemistry, and drug discovery based on molecular structures.
3	Apr. 27	Satou	Medication for Renal Diseases	This course explains (1) drug treatment for glomerular diseases and nephrotic syndrome, (2) drug treatment for renal failure, (3) basic precautions in medication for the patients with renal dysfunction, and (4) representative drug-induced nephropathy.
4	May 11	Dan	Drug Discovery based on Interdisciplinary Research	This course offers an opportunity to understand the current situation of "drug discovery" and to discuss regarding infrastructure to create innovative drugs from Japan.
5	May 18	Ikeda	Overview of Drug and medical device development	To be used in clinical practice, newly developed pharmaceuticals and medical devices need to be approved by Minister for Health, Labour and Welfare. The aim of this course is to give an outline of the way of thinking about securing efficacy and safety which are required for application for approval.
6	May 25	Yanai	The role of independent ethics committee on biomedical and behavioral research involving humans	The clinical trial and human research in Japan has contained several controversial points. An institutional review board (IRB) is a committee that has been formally designated to approve, monitor, and review biomedical and behavioral research involving humans. In this lecture, we will learn the recent progress on the management process to protect the rights and welfare of humans participating as subjects in a research study.

7	Jun. 1	Matsui	Support of clinical study/trial: Roles of CRC	To carry out high-quality clinical study/trial, collaboration of the support staff such as CRC is necessary. In this lecture, students learn the roles and task of CRC. Study coordination for the management clinical trial in a comprehensive way will be introduced.
8	Jun. 8	Inoue	How to make a protocol for successful clinical trials	In this course, students will understand that successful clinical trials are based on the good concept and protocol, and learn how to make it by themselves.
9	Jun. 15	Kato	Development of next generation antibodies and clinical application	The target molecules for antibody drugs are limited. To solve the problem, we recently established CasMab technology to produce cancer-specific monoclonal antibody. The CasMab technology is the platform to develop monoclonal antibodies, which could attack only cancer cells. In this lecture, you can learn not only basic information of antibody but also recent topics about antibody therapy.
10	Jun. 22	Yamaguchi, H.	To provide a more effective and safe cancer chemotherapy	Recently, it has been reported that dose adjustment based on the area under the blood concentration-time curve (AUC) or the trough level makes more effective and safe cancer chemotherapy. In a lecture, the examples of therapeutic drug monitoring (TDM) of molecular target drugs in Tohoku University Hospital will be introduced.
11	Jun. 29	Kikuya	Implementation of cohort study, its practical approach and evidence	Pharmaceutical clinical development is a process of evidence building, and also the outcome itself. In constructing process of pharmaceutical clinical development, practical knowledge of clinical epidemiology, large-scale intervention study, and large-scale observational cohort study are common infrastructure. In this lecture, practice of cross-sectional study of children and cohort study on cardiovascular disease will be introduced, and its historical background and evidence derived from these studies will be discussed.
12	Jul. 6	Nakamura	Serious adverse effects and their predictive biomarkers	This course provides explanations for the occurrence, mechanisms, and administrative measures of serious adverse effects of drugs. Students also learn up-to-date researches regarding predictive biomarkers for the adverse effects.
13	Jul. 13	Yamaguchi, T.	Statistical thinking and interpretation in evidence-based medicine	In this lecture, students will understand the role of statistics in design, conduct, analysis, interpretation and reporting of medical research, and recognize the importance in creation of evidence.
14	Jul. 20	Furumoto	Development of PET radiopharmaceuticals for clinical use	Positron emission tomography, PET, which uses a radiopharmaceutical labeled with a positron emitter, is a useful in vivo imaging technology with high quantitative sensitivity and is available for both small animal and human imaging studies. To develop a new PET radiopharmaceutical is helpful to advance development of imaging diagnosis, pharmacokinetic and pharmacodynamics studies, and proof of mechanism of action. In this class, students learn about a development process of PET radiopharmaceuticals including a molecular design, preclinical evaluation, safety tests, and actual clinical usage.

15	Jul. 27	Endo	Topics of antimicrobial resistance ～ The end of miracle drugs?～	In this course, students will understand the mechanisms of antimicrobial resistance and learn about what change the resistance mechanisms has undergone.
16	Aug. 3	Takayama	Evidence of traditional Japanese Kampo medicine	Kampo medicine has been widely used in the clinical settings. Clinical and pharmacological evidence of Kampo has been constructed in the last decade. In this lecture, we learn the application and evidence of Kampo medicine.
17	unfixed	Hirasawa, Doi, Sato,	Topics in Applied Bio-pharmaceutical Sciences	Students will deapen understanding of the topics in Applied Bio-pharmaceutical Sciences and describe their consideration in their own words.
18				
19				
20				
Record and evaluation method	Evaluate submitted report, attendance and so on.			
Textbook/ Reference				
Preparation and Review				
Language Used in Course	Japanese			
In addition	*DC (Pharmacy)			

Subject	Advanced Biological Sciences				
Course Numbering	Y MP PHA 5 42 J Y LP PHA 5 42 J	Categories	elective		
Preferable Participants	MC 1st	Schedule	Monday 9:00-12:00	Credits	3
Instructor	Junken Aoki, Toshifumi Inada, Takahiro Moriya, Tamaki Yano, Shoichiro Kurata, , Gi-Wook Hwang				
Objectives and summary of class	In this course, students will learn the progress of the latest research on the molecular basis of biological phenomenon, and understand the direction of the future research in drug development and biological chemistry. Students can deepen their understanding of the biological chemistry by practice.				
Goal of study	This course aims to improve the student's ability to understand and explain the molecular basis of biological phenomenon, that is required for researchers in in drug development and biological chemistry.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Jun. 5	Junken Aoki	Lipid signaling (1)	Recently, lysophospholipids such as sphingosine 1-phosphate, lysophoshatidic acid and lysophosphatidylserine have been paid much attention. They produced by specific pathways, act on specific target receptors, mostly G protein-coupled receptors, and exert their function through these receptors. In this course, the fundamental aspects of lysophospholipids will be lectured, in addition to recent advances in the sudty of lysophospholipids.
2			Exercises	Students will be asked for their understanding of the lecture by answering to some questions about the contents of the lecture.
3	Jun. 12	Junken Aoki	Lipid signaling (2)	Eicosanoids such as rostaglandins and leukotriens are well-characterized bioactive lipids. They are also pharmacologically important. They produced by specific pathways, act on specific target receptors, mostly G protein-coupled receptors, and exert their function through these receptors. In this course, the fundamental aspects of eicosanoidss will be lectured, in addition to recent advances in the sudty of lysophospholipids.
4			Exercises	Students will be asked for their understanding of the lecture by answering to some questions about the contents of the lecture.
5	Jun. 19	Toshifumi Inada	Gene regulation at the RNA level	Gene regulation at the RNA level plays an important role to acquire the asymmetry and diversity of the gene products. This course provides explanations of an important molecular basis of gene regulation by RNA and its quality control systems. Students also learn about the medical and pharmaceutical application of the quality control systems.
6			Exercises	This course aims to improve students' ability to comprehension and expression by the exercises on the mechanisms of gene regulation at the RNA level.

7	Jun. 26	Toshifumi Inada	RNA and disease	RNA processing plays very important roles to acquire diversity of the gene products. This course describes the diseases caused by the abnormality in gene control at the RNA level including splicing. Students also learn about the medical and pharmaceutical application of the gene control at the RNA level.
8			Exercises	This course aims to improve students' ability to comprehension and expression by the exercises on RNA disease.
9	Jul. 3	Takahiro Moriya	Molecular mechanism of the circadian clock in mammals	It became recently clear that the abnormality of the biological rhythm with a period of 24 hr (circadian rhythm) is a considerble risk factor not only for the sleep disorder but also for the mood disorder, metabolic syndrome and malignant tumor. In this course, students will learn about the molecular mechanism of circadian clockwork in mammals and understand how an abnormality of circadian clock increases a risk of these diseases. Students will gain a perspective to consider the mechanisms underlying the clinical observation that a degree of action/adverse effects of clinically available drugs changes across the time of drug administration.
10			Practice of the above theme	Students will perform a practice about the molecular clockwork using several methods to improve students' ability to understand the circadian clock and to express their thoughts about it.
11	Jul. 10	Takahiro Moriya	Development of the central nervous system	In the human brain, over 100 billion nerve cells, called neurons, form an astronomical number of synaptic connections which is necessary for the normal brain functions. In this course, students will learn about the basic knowledge of the development of the central nervous system. Students also will learn about the representative epoc-making experiments that have contributed an advance of understanding the molecular mechanisms of the central nervous system development.
12			Practice of the above theme	Students will perform a practice about the neural development using several methods to improve students' ability to understand the brain ontogeny and to express their thoughts about it.
13	Jul. 24	Tamaki Yano	Physiological function of autophagy	Autophagy is a fundamental process involved in the turnover of molecules and organelles in the cell cytoplasm to maintain cellular homeostasis. This lecture provides an overview of molecular mechanism and the physiological function of autophagy, with the focus on its role on immunity, neurodegenerative diseases, and tissue homeostasis.
14			Related practice	Aiming to improve students' ability to review and describe on cellular homeostasis and physiological function of autopthagy.

15	Sep. 4	Shoichiro Kurata	Molecular mechanism of recognition and elimination of pathgens in innate immunity	Innate immunity is evolutionarily conserved host defense system independent of the gene rearrangement. This lecture provides an overview of molecular mechanism of recognition and elimination of various pathogens in innate immunity.
16			Related practice	This course aims to improve students' ability to comprehension and expression by the exercises on the molecular mechanisms of innate immunity.
17	Sep. 11	Gi-Wook Hwang	Environmental pollutants toxicity and defense mechanisms against their toxiciy	Environmental pollutants can confer harmful effects on human health. On the other hand, human has the ability to act defensively against their toxicity. This lecture provides explanation about harmful effects on human health by environmental pollutants, and the defense mechanisms against their toxicity.
18			Related practice	This practice aims to improve students' ability to comprehend and express about environmental pollutants toxicity and the defense mechanisms against their toxicity by using various type of guidance.
19	Sep. 25	Gi-Wook Hwang	Mechanisms involved in the determination of chemical sensitivity	There are many chemicals that affect the human health, and their degree of toxicity differs greatly by individual and racial.This lecture provides explanation of mechanisms involved in the determination of chemical sensitivity.
20			Related practice	This practice aims to improve students' ability to comprehend and express about mechanisms involved in the determination of chemical sensitivity by using various type of guidance.
21		Junken Aoki, Toshifumi Inada, Takahiro Moriya, Tamaki Yano, Shoichiro Kurata, Gi-Wook Hwang	Special lecture	To introduce the latest knowledge in biological chemistry. Select interested one from the special lectures.
22			Related practice	This practice aims to help students understand the knowledge of the special lecture through study of the related reviews and papers, and to further improve students' ability to write reports.
Record and evaluation method	Students are evaluated on their discussion, presentation, and report in the lecture and the related practice and their report of the special lecture.			
Textbook/ Reference	Lecturers introduce related textbooks and papers in their lecture.			
Preparation and Review	Understanding of the lectures and development of the practices by reference books and literatures introduced by each lecturers			
Language Used in Course	Japanese			
In addition				

Subject	Advanced Medicinal Chemistry				
Course Numbering	Y MP PHA 5 31 J Y LP PHA 5 31 J	Categories	Elective		
Preferable Participants	MC 1st	Schedule	Thursday 9:00-12:00	Credits	3
Instructor	Yoshiteru Oshima, Takayuki Doi, Hidetoshi Tokuyama, Naoki Kanoh, Haruhisa Kikuchi				
Objectives and summary of class	This lecture course will explain molecules having potential as a new drug from various point of view including synthetic organic chemistry, structural chemistry, chemical functions, and theoretical calculations to understand approaches to creat new drugs such as construction of molecules, synthetic methodologies, designing new molecules, and exploration of new drug candicates from the nature. Practices of these subjects help students' better understanding of medicina chemistry.				
Goal of study					
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Jun. 15	Hidetoshi Tokuyama	Efficient synthesis of Biologically active compounds	This lecure will pick-up biologically active compunds, which has a potential of new type of drug lead, and expain efficient synthesis based on the rational retrosynthetic analysis.
2			Practice	The practice of planning synthetic route of biologically active compounds in several ways aims to improve students' understanding and presentation skills.
3	Jun. 22	Haruhisa Kikuchi	Eploration of natural resource and material	Many drugs were developed based on natural products as the lead, which had been found in animals, plants, and micriorganisms. It has been desired that strongly active and structurally unknown natural products will be found from nature. To use natural resources, on the other hand, one should care environmental protection. In this lecture, students will overview historical background of the useful natural resources which have played important role for the development of drug and its future utility.
4			Practice	Practice of exploring natural resources・materials in several ways aims to imporve students' understanding and presentation skills.
5	Jun. 29	Naoki Kanoh	Target identification of biologically active small molecules by using chemical proteomics approaches	Identification of molecular targets is an important step for understanding mode-of-action of biologically active small molecules. This lecture will introduce recent methods and protocols for identifying molecular targets for bioactive natural and sythetic small molecules by using chemical proteomic approaches.
6			Practice	The practice of planning methods for target identification of several bioactive small molecules aims to improve students' understanding and presentation skills.

7	Jul. 6	Yoshiteru Oshima	Determination of absolute stereochemistry of organic compounds	Sterechemistry is highly important factor for biological activity of drugs. In this lecture, students will learn method to determine absolute stereochemistry of organic compounds based on circular dichroism.
8			Practice	The practice to determine absolute stereochemistry of organic compounds in several ways aims to imporve students' understanding and presentation skills.
9	Jul. 13	Takayuki Doi	Introduction to theoretical calculations	Theroretical calculations play important role for designing and analyzing new drug. In this lecture, students will learn and understand fundamental theory of molecular force field calculation and molecular orbital calculation. Students also learn minimization of energy of compound by structure optimization and conformational analysis.
10			Practice	The practice using SPARTAN sims to imporve students' understanding the above issues.
11	Jul. 20	Takayuki Doi	Application of theoretical calculations	In this lecuture, students will learn HOMO and LUMO by using molecular orbital calculations and their visualization. In addition, students will understand analysis of transition state structure.
12			Practice	The practice using SPARTAN sims to imporve students' understanding the above issues.
13	TBD	TBD	Special Lecture	This lecture provides the latest knowledge about medicinal chemistry.
14				
15				
16			Practive	The practice provides students with opportunities to summarize the contents of the special lecture by their own words and to read and summarize the related review articles and papers to obtain better understanding. These assignments will help students train ability of writing skills.
17				
18				

Record and evaluation method	Evaluation is performed comprehensively based on attendance of each lecture and practice, presentations, submitted reports, attendance of special lectures, and submitted reports of special lectures.
Textbook/ Reference	The text book or the reference will be designated at the beginning of each of lecture.
Preparation and Review	Students should prepare related preliminary knowledge beforehand about the content of the lecture. After lecture, understanding will be deepened by further studying on the contents of the lecture.
Language Used in Course	Japanese
In addition	

Subject	Advanced Clinical Pharmacy/ Special Lecture in Pharmacy I*				
Course Numbering	Y MP PHA 5 61 J Y LP PHA 5 61 J Y PH PHA 7 11 J*	Categories	Elective/ Required*		
Preferable Participants	MC 1st /DC 1st*	Schedule	Monday 9:00-12:00	Credits	3 /2*
Instructor	Yoshihisa Tomioka, Masahiro Hiratsuka, Nariyasu Mano, Nobuyuki Takahashi, Yuriko Murai, Noriyasu Hirasawa, Toshihide Saga, Shoji Takamatsu, Fumiyoshi Ojima, Norio Takahashi, Yotaro Matsumoto				
Objectives and summary of class	In this course, students learn pathology, practical pharmacotherapy planning and outcome evaluation, contribution based on pathological knowledge to drug discovery, post-marketing evaluation, evaluation for drug information, proper medication use and, practice of medical care and disease management.				
Goal of study	The purpose of this course is to help students explain the basic roles of medical practitioner as a leading pharmacist candidate.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Oct. 2	Yoshihisa Tomioka	Introduction for medical pharmaceutics	Students can deepen their understanding of the importance of pharmaceutical care, patient care, pharmacist's disease management and the need for specialization of pharmacist.
2			Its execise and practice	Identify problems, explore and priorities potential strategies.
3	Oct. 16	Fumiyoshi Ojima	Outcome evaluation for pharmacotherapy and clinical research	Students can deepen understanding of the importance of the evaluation for a patient's vital signs in order to find drug thrapy promlems such as side effects.
4			Its execise and practice	Actually carry out the measurement of vital signs. Learn the correct procedure them. To understand how to evaluate them as a pharmacist.
5	Oct. 23	Nariyasu Mano	Latest chemical diagnosis	Students can deepen their understanding of the latest developments for advances in chemical diagnostics of various diseases using mass spectrometry, practice of TDM, and biomarker reseach and developments.
6			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways in chemical diagnostics.
7	Oct. 30	Shoji Takamatsu	From drug deveoment to post-marketing safety measures	Students can outline the example of the approval and post-marketing safety measures based on recent pharmaceutical administration and regulations in Japan and international trends.
8			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways in chemical diagnostics.
9	Nov. 6	Yuriko Murai	Analysis, evaluation and the use of drug information	The course provides explanations of the proper use of medicine from a drug informational point of view to deepen understanding of the medical care, and also refers to the medical risk communication and drug information specialist pharmacist.
10			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways such as group discussion, role playing in the drug information analysis, evaluation and the use.

11	Nov. 13	Masahiro Hiratsuka	Individualized drug therapy with genetic polymorphism diagnosis	Students can understand several clinical examples for individualized drug therapy related to drug selection, dose planning and side effect avoidance through genetic polymorphism diagnosis for drug metabolizing enzyme and/or drug transporter.
12			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways in the individualized drug theraphy with genetic polymorphism diagonosis .
13	Nov. 20	Toshihide Saga	Theory and practice of risk management	Students can learn the basic idea of the medical safety, and deepen their understanding of the importance of management of risk as a pharmacist participating to the highly advanced medical care/technology.
14			Its execise and practice	Based on the real incident example, students will analze the factors and plan the measures.
15	Nov. 27	Nobuyuki Takahashi	Pathology and therapy for pregnancy-induced hypertension	Students learn the definition, classification and pathology for gestational hypertension. They also discuss the therapy, problems and future perspectives for gestational hypertension.
16			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways in the individualized drug theraphy with genetic polymorphism diagonosis .
17	Dec. 4	Noriyasu Hirasawa	Advances in pharmacotherapy of diabetes	This lecture provides overview about pathological conditions of diabetes and mode of actions of anti-diabetic drugs. Recent development of new types of anti-diabetic drugs caused the change of strategy of pharmacotherapy. This lecture helps the student better understand the most up-to-date pharmacotherapy of diabetes.
18			Its execise and practice	Students understand the most up-to-date pharmacotherapy of diabetes and describe it in their own words.
19	Dec. 11	Yotaro Matsumoto	Organic chemistry and pharmacy practice	Students learn the importance of the thinking and idea for organic chemistry to understand pharmacy practice and medicine widely.
20			Its execise and practice	In order to improve scientific understanding and thinking, carry out group discussion about when the organic chemistry will be important during pharmacy practice.
21	Dec. 18	Norio Takahashi	Theory and practice of medical economy	Students can understand the theory and practice related to pharmacoenomical approach from the point of view of hospital management and patient benefit. They also understand the position of the generic medicine and biosimilar pharmaceutical.
22			Its execise and practice	Students can deepen understanding from the concrete examples of pharmacoeconomics.
23	Dec. 25	Yoshihisa Tomioka	The role and responsibility of oncology pharmacists	Students understand the role and responsibility of oncology pharmacist. They also understand the need and importance for research to be more safe and effective pharmacotherapy for the next generation.
24			Its execise and practice	In order to improve understanding power and expression power, carry out something practices in a variety of ways in the desing of prescription, side effect monitoring and avoidance to be serious progress.
25	unfixed	Yoshihisa Tomioka Masahiro Hiratsuka Nariyasu Mano Nobuyuki Takahashi Yuriko Murai Noriyasu Hirasawa Yotaro Matsumoto	Course special lecture	Students select a special lecture interested, and deepen understaning of the latest findings in the medical pharmaceutics.
26			Its execise and practice	In order to improve their knowledge precisely and writing skill such as reports, students summarized the contents of a selected special lecture and read some related review and/or original articles.

Record and evaluation method	Presentations and class participation, and submitted reports, attendance and so on are evaluated.
Textbook/ Reference	Specify in each lecture.
Preparation and Review	Preparation: Participants will read and evaluate a original papar related to the each lecture. Review: Participants will read and evaluate a review article related to the each lecture and practice.
Language Used in Course	Japanese
In addition	*DC (Pharmacy)

Subject	Advanced Organic Chemistry				
Course Numbering	Y MP PHA 5 21 J Y LP PHA 5 21 J	Categories	Elective		
Preferable Participants	MC 1st	Schedule	Thursday 9:00-12:00	Credits	3
Instructor	Masahiko Yamaguchi, Hidetsura Cho, Yoshinori Kondo, Yoshiharu Iwabuchi, Hidetoshi Tokuyama, Mieko Arisawa, Masanori Shigeno				
Objectives and summary of class	This lecture course will illiustrate the essential concept and mechanism of organic reactions and synthetic methodology for efficient construction of drug candidate molecules. Practices of these subjects help students' better understanding of organic chemistry.				
Goal of study					
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				

Term	Date	Lecturer	Theme	Contents
1	Oct. 5	Masahiko Yamaguchi, Mieko Arisawa	Chemistry on chemical reactions	Understanding on the structure and reactivity of reaction intermediates is critical to develop synthetic chemical reactions and to understand biological chemical reactions. Such examples will be discussed.
2			Practice	The practice for understanding and designing of synthetic chemical reactions with views on quantum mechanics and statistical mechaics.
3	Oct. 12	Masahiko Yamaguchi, Mieko Arisawa	Chemistry on catalytic reactions	Transition-metal-catalyzed reactions for effective formation of carbon-carbon and carbon-heteroatom bonds will be explained.
4			Practice	The practice for designing catalytic reactions and structure determinations aims to improve students' understanding and presentation skills.
5	Oct. 19	Hidetsura Cho	Discovery and development of new medicines	The lecture on the practical procedure of discovery and development of new medicines will be provided according to my text book.
6			Practice	Your report must be summarized on your understanding of research and development for new medicines.
7	Oct. 26	Yoshinori Kondo	Selective functionalization of aromatic and heteroaromatic compounds	Aromatic and heteroaromatic compounds are very important stuructural units in medicinal chemistry. In this lecture, students will learn various methodologies to functionalize aromatic and heteroaromatic compounds selectively.
8			Practice	Practice of using various methods for construction of poly functionalized aromatic and heteroaromatic compounds.
9	Nov. 2	Masanori Shigeno	Functionalization of unreactive chemical bonds	Direct functionalization of C-H and C-C bonds is important because of providing a straightforward synthetic route from readily available substances to target products, which will be explained in this lecture.
10			Practice	Practice of understanding various methodologies utilizing unreactive chemical bonds.

11	Nov. 9	Yoshiharu Iwabuchi	Stereoelectronic effect	The concept of stereoelectronic effects exerting on organic molecular conformation, reactivity, and selectivity will be explained.
12			Practice	The practice of undersitanding and predicting chemo, regio-, and diastereoselecitive reactions to improve strudents' skills.
13	Nov. 16	Hidetoshi Tokuyama	Chemistry of heteteroatom	A hetero elements have useful chemical reactivities for organic synthesis. This lecture will deepen our understanding through characteristics of representative hetero elements and practical examples utilizing the characteristics in organic synthesis.
14			Practice	Students will practice reaction mechanisms on characteristic reactions of hetero elements to deepen their understanding.
15	TBD	TBD	Special Lecture	This lecture provides the latest knowledge about organic chemistry.
16			Practice	The practice provides students with opportunities to summarize the contents of the special lecture by their own words and to read and summarize the related review articles and papers to obtain better understanding. These assignments will help students train ability of writing skills.
17				
18				

Record and evaluation method	Evaluation is performed comprehensively based on attendance of each lecture and practice, presentations, submitted reports, attendance of special lectures, and submitted reports of special lectures.
Textbook/ Reference	The text book or the reference will be designated at the beginning of each of lecture.
Preparation and Review	Students should prepare related preliminary knowledge beforehand about the content of the lecture. After lecture, understanding will be deepened by further studying on the contents of the lecture.
Language Used in Course	Japanese
In addition	

Subject	Advanced Biochemistry I				
Course Numbering	YMP-PHA541J YLP-PHA541J	Categories	elective		
Preferable Participants	MC 1st	Schedule	Wednesday 9:00-12:00	Credits	3
Instructor	Tohoku University Graduate School Faculty Members				
Objectives and summary of class	In Applied Biochemistry I, students will learn the progress of the most cutting-edge biochemical research. It is a joint lecture for the doctoral program (first term) of the Graduate School of Pharmaceutical Sciences, Graduate School of Science, Graduate School of Engineering, Graduate School of Agriculture, Graduate School of Life Sciences, Graduate School of Environmental Science, and students of Doctoral Course of Graduate School of Medicine, Graduate School of Dentistry Doctoral Student. Studends will receive the credits by attending Tohoku University Graduate Student Chemistry Lecture (from April to July) to be held at Graduate School of Agriculture and submitting reports.				
Goal of study	This course aims to acquire the latest knowledge on research promotion methods and techniques by learning state-of-the-art research in the field of biochemistry.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				
Term, Date, Lecturer, Theme and Contents	The schedule of the lectures from April to July will be announced separately.				
Record and evaluation method	Students are evaluated on their report of the special lecture.				
Textbook/ Reference	As the content is diverse, textbooks are not specifically set up.				
Preparation and Review					
Language Used in Course	Japanese				
In addition					

Subject	Advanced Biochemistry II				
Course Numbering	YMP-PHA641 YLP-PHA641	Categories	elective		
Preferable Participants	MC 1st	Schedule	Wednesday 9:00-12:00	Credits	3
Instructor	Tohoku University Graduate School Faculty Members				
Objectives and summary of class	In Applied Biochemistry II, students will learn the progress of the most cutting-edge biochemical research. It is a joint lecture for the doctoral program (first term) of the Graduate School of Pharmaceutical Sciences, Graduate School of Science, Graduate School of Engineering, Graduate School of Agriculture, Graduate School of Life Sciences, Graduate School of Environmental Science, and students of Doctoral Course of Graduate School of Medicine, Graduate School of Dentistry Doctoral Student. Studends will receive the credits by attending Tohoku University Graduate Student Chemistry Lecture (from A September to December) to be held at Graduate School of Agriculture and submitting reports.				
Goal of study	This course aims to acquire the latest knowledge on research promotion methods and techniques by learning state-of-the-art research in the field of biochemistry.				
Method of class	Lecture・Practice・Training・On-site training・SGD・PBL・Roleplay・e-learning・Others( )				
Term, Date, Lecturer, Theme and Contents	The schedule of the lectures from September to December will be announced separately.				
Record and evaluation method	Students are evaluated on their report of the special lecture.				
Textbook/ Reference	As the content is diverse, textbooks are not specifically set up.				
Preparation and Review					
Language Used in Course	Japanese				
In addition					