# Doctor of Philosophy Program in Pharmaceutical Sciences (International Program/Revised Program 2018) Department of Biopharmacy, Department of Pharmaceutical Chemistry, Department of Pharmacology and Toxicology, Department of Pharmacognosy

### Name of the Program

| Thai    | หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาวิทยาการทางเภสัชศาสตร์ (หลักสูตรนานาชาติ) |
|---------|---|
| English | Doctor of Philosophy Program in Pharmaceutical Sciences                     |
|         | (International Program)   |

### **Title of the Degree**

| Thai    | ปรัชญาดุษฎีบัณฑิต (วิทยาการทางเภสัชศาสตร์)     |
|---------|--|
|         | ปร.ด. (วิทยาการทางเภสัชศาสตร์)                 |
| English | Doctor of Philosophy (Pharmaceutical Sciences) |
|         | Ph.D. (Pharmaceutical Sciences)                |

### **Study Venue**

Faculty of Pharmacy, Silpakorn University, Sanam Chandra Palace Campus, Nakhon Pathom

# Collaboration with other institutes

This curriculum is collaborated with the Graduate School of Pharmaceutical Sciences of Chiba University (Japan) under the Double Doctoral Degree Program. The program provides graduate students the opportunities to study and do research at Chiba University. Student can also receive two Doctoral's degrees from Silpakorn University and Chiba University.

### **Degree Awarded**

Student(s) enrolling the Double Doctoral Degree Program will receive a Doctor of Philosophy (Pharmaceutical Sciences) from Silpakorn University and a Doctor of Philosophy (Pharmaceutical Sciences) from the Graduate School of Pharmaceutical Sciences of Chiba University. However, students who do not participate in the program will receive only a Doctor of Philosophy (Pharmaceutical Sciences) from Silpakorn University.

### Objectives

1. To produce Ph.D. graduates imbued with responsible leadership in pharmaceutical sciences and to produce qualified professionals who can advance science and medical technology in pharmaceutical sciences according to the Science of the King for sustainable development of public health in Thailand.

2. To produce researchers who demonstrate the capability to acquire new knowledge or theory in pharmaceutical sciences independently, as well as competative skills in advance research that will support sustainable both domestic, and international pharmaceutical industries.

### **Qualifications of Applicants**

1. Requirements of a study plan as the followings:

(1) Plan 1.1 and 2.1

Holder of a Master degree in pharmacy, science, or other related fields of

study

(2) Plan 1.2 and 2.2

Holder of a Bachelor degree in pharmacy or related fields with a minimum GPA of 3.50 (or equivalent) on a 4.00 scale

2. English examination result according to the committee of Higher Education council or to the announcement of Silpakorn University as of standard English proficiency test for the admission of doctorate study

3. Accordance with Silpakorn University's 2007 Regulations on Graduate Study and/or later revision and/or updated amendment.

4. Other qualifications may also apply as reviewed by authorized committee of the Faculty of Pharmacy based on work or research experience.

### **Curriculum Structure**

| 1. Plan 1. | 1 |
|------------|---|
|------------|---|

| Core courses (non-credit)     | 4  | credits |
|-------------------------------|----|---------|
| Thesis (equivalent to)        | 48 | credits |
| Total credits for the program | 48 | credits |
|                               |    |         |

# 2. Plan 1.2

| Core courses (non-credit)     | 7  | credits |
|-------------------------------|----|---------|
| Thesis (equivalent to)        | 72 | credits |
| Total credits for the program | 72 | credits |

### 3. Plan 2.1

| Core courses                                   | 4  | credits |
|--|----|---------|
| Elective courses not less than                 | 8  | credits |
| Thesis (equivalent to)                         | 36 | credits |
| Minimum credits earned from the entire program | 48 | credits |

### 4. Plan 2.2

| Core courses                                   | 7  | credits |
|--|----|---------|
| Elective courses not less than                 | 17 | credits |
| Thesis (equivalent to)                         | 48 | credits |
| Minimum credits earned from the entire program | 72 | credits |

## **Course List**

1. Plan 1.1

|         | <b>1.1 Core Courses</b> (non-credit) 4 credits |          |
|---------|--|----------|
| 551 641 | Seminar in Pharmaceutical Sciences I           | 1(0-3-0) |
| 551 642 | Seminar in Pharmaceutical Sciences II          | 1(0-3-0) |
| 551 643 | Seminar in Pharmaceutical Sciences III         | 1(0-3-0) |
| 551 644 | Seminar in Pharmaceutical Sciences IV          | 1(0-3-0) |
|         |  |          |

- **1.2 Thesis** (equivalent to) 48 credits
- 550 905 Thesis

equivalent to 48 credits

equivalent to 72 credits

### 2. Plan 1.2

|         | 2.1 Core Courses (non-credit) 7 credits                  |          |
|---------|--|----------|
| 550 531 | Advanced Research Methodology in Pharmaceutical Sciences | 3(3-0-6) |
| 551 641 | Seminar in Pharmaceutical Sciences I                     | 1(0-3-0) |
| 551 642 | Seminar in Pharmaceutical Sciences II                    | 1(0-3-0) |
| 551 643 | Seminar in Pharmaceutical Sciences III                   | 1(0-3-0) |
| 551 644 | Seminar in Pharmaceutical Sciences IV                    | 1(0-3-0) |
|         |  |          |

- 2.2 Thesis (equivalent to) 72 credits
- 550 906 Thesis

# 3. Plan 2.1

# 3.1 Core Courses 4 credits551 641Seminar in Pharmaceutical Sciences I1(0-3-0)551 642Seminar in Pharmaceutical Sciences II1(0-3-0)551 643Seminar in Pharmaceutical Sciences III1(0-3-0)551 644Seminar in Pharmaceutical Sciences IV1(0-3-0)

**3.2 Elective Courses** 8 credits minimum, Choose from one of or any specialty subject(s) below

| (1) Biopharmacy Subjects                              |   |
|---|---|
| Advanced Cellular and Molecular Biology               | 3(3-0-6)  |
| Instrumentation in Molecular Biology                  | 1(1-0-2)  |
| Advanced Human Physiology                             | 3(3-0-6)  |
| Cellular and Molecular Biology for Biopharmaceuticals | 2(2-0-4)  |
| Development   |   |
| Applied Microbiology                                  | 2(2-0-4)  |
| Applied Immunology                                    | 2(2-0-4)  |
| Molecular Virology                                    | 2(2-0-4)  |
| Special Problems in Pharmaceutical Sciences I         | 2(1-3-2)  |
| Special Problems in Pharmaceutical Sciences II        | 1(0-3-0)  |
| Cellular and Molecular Biotechnology Laboratory       | 1(0-3-0)  |
| Cellular and Molecular Bacteriology                   | 2(1-3-2)  |
|   | <ul> <li>(1) Biopharmacy Subjects</li> <li>Advanced Cellular and Molecular Biology</li> <li>Instrumentation in Molecular Biology</li> <li>Advanced Human Physiology</li> <li>Cellular and Molecular Biology for Biopharmaceuticals</li> <li>Development</li> <li>Applied Microbiology</li> <li>Applied Immunology</li> <li>Molecular Virology</li> <li>Special Problems in Pharmaceutical Sciences I</li> <li>Special Problems in Pharmaceutical Sciences II</li> <li>Cellular and Molecular Biotechnology Laboratory</li> <li>Cellular and Molecular Bacteriology</li> </ul> |

| 561 535 | Applied Microbiology Laboratory                                 | 1(0-3-0) |
|---------|---|----------|
| 561 601 | Signal Transduction   | 2(2-0-4) |
| 561 602 | Biological Assay  | 2(2-0-4) |
| 561 603 | Advanced Application of Drug Biotransformation                  | 3(3-0-6) |
| 561 604 | Advanced Cellular and Molecular Bacteriology                    | 1(1-0-2) |
| 561 605 | Current Topics in Advanced Biopharmaceutical Sciences           | 1(1-0-2) |
| 561 606 | Advanced Immunology   | 3(3-0-6) |
| 561 631 | <b>Bioinformatics in Pharmaceutical Sciences</b>                | 3(2-3-4) |
| 561 632 | Biological Assay Laboratory                                     | 1(0-3-0) |
|         | (2) Pharmaceutical Chemistry Subjects                           |          |
| 564 501 | Advanced Instrumental Method of Analysis                        | 4(2-6-4) |
| 564 502 | Advanced Organic Pharmaceutical Chemistry                       | 3(3-0-6) |
| 564 503 | Structure Elucidation of Organic Compounds                      | 3(3-0-6) |
| 564 504 | Advanced Drugs Design   | 3(3-0-6) |
| 564 505 | Special Problems in Advanced Pharmaceutical Chemistry           | 3(1-6-2) |
| 564 506 | Current Topics in Pharmaceutical Chemistry                      | 2(2-0-4) |
| 564 601 | Pharmaceutical Synthesis  | 3(2-3-4) |
|         | (3) Pharmacology and Toxicology Subjects                        |          |
| 565 603 | Systemic Pharmacology   | 4(4-0-8) |
| 565 604 | Advanced Pharmacology   | 4(4-0-8) |
| 565 605 | Advanced Toxicology   | 3(3-0-6) |
| 565 702 | Research Methods in Pharmacology and Toxicology                 | 2(1-3-2) |
| 565 703 | Receptor Pharmacology and Signal Transduction                   | 3(3-0-6) |
| 565 706 | Principle and Applications of Toxicology                        | 2(2-0-4) |
| 565 802 | Current Topics in Pharmacology and Toxicology                   | 2(2-0-4) |
| 565 803 | Special Problems in Pharmacology and Toxicology                 | 2(0-6-0) |
| 565 804 | Genetic Technology and Gene Therapy                             | 3(2-3-4) |
|         | (4) Herbal Science and Natural Products Subjects                |          |
| 551 604 | Development of Pharmaceutical Products from Medicinal<br>Plants | 3(2-3-4) |
| 551 607 | Natural Bioactive Compounds                                     | 3(2-3-4) |
| 551 610 | Community Pharmacognosy   | 3(2-3-4) |
| 566 401 | Medical Herbs   | 3(2-3-4) |
| 566 501 | Chemistry of Natural Products                                   | 4(3-3-6) |
| 566 502 | Separation Techniques for Medicinal Plants                      | 3(2-3-4) |
| 566 503 | Advanced Research in Natural Products                           | 3(2-3-4) |
| 566 712 | Analysis of Natural Products                                    | 3(2-3-4) |
| 566 732 | Biotechnology for Medicinal Plants Research                     | 3(2-3-4) |
|         |   |          |

| 550 904 | <b>3.3 Thesis</b> (equivalent to) 36 credits0 904Thesis          | dits<br>equivalent to 36 credits |
|---------|--|----------------------------------|
|         | <ul><li>4. Plan 2.2</li><li>4.1 Core Courses 7 credits</li></ul> |                                  |

| 550 531 | Advanced Research Methodology in   | Pharmaceutical Sciences | 3(3-0-6) |
|---------|------------------------------------|-------------------------|----------|
| 551 641 | Seminar in Pharmaceutical Sciences | Ι                       | 1(0-3-0) |
| 551 642 | Seminar in Pharmaceutical Sciences | II                      | 1(0-3-0) |
| 551 643 | Seminar in Pharmaceutical Sciences | III                     | 1(0-3-0) |
| 551 644 | Seminar in Pharmaceutical Sciences | IV                      | 1(0-3-0) |

**4.2 Elective Courses** 17 credits minimum, Choose from one of or any specialty subject(s) below

| 3       |   |          |
|---------|---|----------|
|         | (1) Biopharmacy Subjects                              |          |
| 561 401 | Advanced Cellular and Molecular Biology               | 3(3-0-6) |
| 561 403 | Instrumentation in Molecular Biology                  | 1(1-0-2) |
| 561 502 | Advanced Human Physiology                             | 3(3-0-6) |
| 561 503 | Cellular and Molecular Biology for Biopharmaceuticals | 2(2-0-4) |
|         | Development   |          |
| 561 505 | Applied Microbiology                                  | 2(2-0-4) |
| 561 506 | Applied Immunology                                    | 2(2-0-4) |
| 561 507 | Molecular Virology                                    | 2(2-0-4) |
| 561 531 | Special Problems in Pharmaceutical Sciences I         | 2(1-3-2) |
| 561 532 | Special Problems in Pharmaceutical Sciences II        | 1(0-3-0) |
| 561 533 | Cellular and Molecular Biotechnology Laboratory       | 1(0-3-0) |
| 561 534 | Cellular and Molecular Bacteriology                   | 2(1-3-2) |
| 561 535 | Applied Microbiology Laboratory                       | 1(0-3-0) |
| 561 601 | Signal Transduction                                   | 2(2-0-4) |
| 561 602 | Biological Assay                                      | 2(2-0-4) |
| 561 603 | Advanced Application of Drug Biotransformation        | 3(3-0-6) |
| 561 604 | Advanced Cellular and Molecular Bacteriology          | 1(1-0-2) |
| 561 605 | Current Topics in Advanced Biopharmaceutical Sciences | 1(1-0-2) |
| 561 606 | Advanced Immunology                                   | 3(3-0-6) |
| 561 631 | <b>Bioinformatics in Pharmaceutical Sciences</b>      | 3(2-3-4) |
| 561 632 | Biological Assay Laboratory                           | 1(0-3-0) |
|         | (2) Pharmaceutical Chemistry Subjects                 |          |
| 564 501 | Advanced Instrumental Method of Analysis              | 4(2-6-4) |
| 564 502 | Advanced Organic Pharmaceutical Chemistry             | 3(3-0-6) |
| 564 503 | Structure Elucidation of Organic Compounds            | 3(3-0-6) |
| 564 504 | Advanced Drugs Design                                 | 3(3-0-6) |
| 564 505 | Special Problems in Advanced Pharmaceutical Chemistry | 3(1-6-2) |
| 564 506 | Current Topics in Pharmaceutical Chemistry            | 2(2-0-4) |

# 564 601Pharmaceutical Synthesis

3(2-3-4)

| (3) Pharmacology and Toxicology Subjects |   |          |  |
|--|---|----------|--|
| 565 603                                  | Systemic Pharmacology                                 | 4(4-0-8) |  |
| 565 604                                  | Advanced Pharmacology                                 | 4(4-0-8) |  |
| 565 605                                  | Advanced Toxicology                                   | 3(3-0-6) |  |
| 565 702                                  | Research Methods in Pharmacology and Toxicology       | 2(1-3-2) |  |
| 565 703                                  | Receptor Pharmacology and Signal Transduction         | 3(3-0-6) |  |
| 565 706                                  | Principle and Applications of Toxicology              | 2(2-0-4) |  |
| 565 802                                  | Current Topics in Pharmacology and Toxicology         | 2(2-0-4) |  |
| 565 803                                  | Special Problems in Pharmacology and Toxicology       | 2(0-6-0) |  |
| 565 804                                  | Genetic Technology and Gene Therapy                   | 3(2-3-4) |  |
|  | (4) Herbal Science and Natural Products Subjects      |          |  |
| 551 604                                  | Development of Pharmaceutical Products from Medicinal | 3(2-3-4) |  |
|  | Plants  |          |  |
| 551 607                                  | Natural Bioactive Compounds                           | 3(2-3-4) |  |
| 551 610                                  | Community Pharmacognosy                               | 3(2-3-4) |  |
| 566 401                                  | Medical Herbs   | 3(2-3-4) |  |
| 566 501                                  | Chemistry of Natural Products                         | 4(3-3-6) |  |
| 566 502                                  | Separation Techniques for Medicinal Plants            | 3(2-3-4) |  |
| 566 503                                  | Advanced Research in Natural Products                 | 3(2-3-4) |  |
| 566 712                                  | Analysis of Natural Products                          | 3(2-3-4) |  |
| 566 732                                  | Biotechnology for Medicinal Plants Research           | 3(2-3-4) |  |
|  |   |          |  |

4.3 Thesis (equivalent to) 48 credits

| 550 905 | Thesis | equivalent to 48 credits |
|---------|--------|--------------------------|
| 550 705 | 110313 | equivalent to 40 credits |

# **Course Description**

| 550 531 | Advanced Research Methodology in Pharmaceutical    | 3(3-0-6) |  |
|---------|--|----------|--|
|         | Sciences   |          |  |
|         | Condition: Non-credit course, assessed as S/U      |          |  |
|         | (for students enrolling in study plan 1.1 and 1.2) |          |  |
|         |  |          |  |

Systematic approaches in conducting advanced research, including formulation of research topic and planning of research project; research design; operational concept of variables, data, populations and samples; research proposal preparation; statistics for research; analysis and interpretation of research data; research work dissemination; research ethics.

**550 904** Thesis equivalent to 36 credits Conducting a research study in pharmaceutical sciences topics under supervision of a thesis advisor.

550 905 Thesis equivalent to 48 credits Conducting a research study in pharmaceutical sciences topics under supervision of a thesis advisor.

### 550 906 Thesis equivalent to 72 credits

Conducting a research study in pharmaceutical sciences topics under supervision of a thesis advisor.

### 551 604 **Development of Pharmaceutical Products from Medicinal** 3(2-3-4) **Plants**

Preparation of raw plant materials and herbal extracts, development of suitable product formulation, quality control and related regulations for manufacturing pharmaceutical products from medicinal plants.

#### **Natural Bioactive Compounds** 551 607 3(2-3-4)

Study on chemical structures and bioactivities of natural compounds for pharmaceutical and medical applications.

### 551 610 **Community Pharmacognosy**

Community perceptions and beliefs in folk medicine, herbal and traditional medicine formulations, medication and problems of herbal medicine used in communities, application of pharmacognosy knowledge for systematic analysis including related regulations on herbal medicine.

### 551 641 Seminar in Pharmaceutical Sciences I 1(0-3-0)Condition: Non-credit course, assessed as S/U

# (for students enrolling in study plan 1.1 and 1.2)

Searching and compiling data in pharmaceutical sciences from various sources, analysis of collected information for presentation and rational discussion.

### 551 642 Seminar in Pharmaceutical Sciences II 1(0-3-0)

Condition: Non-credit course, assessed as S/U (for students enrolling in study plan 1.1 and 1.2)

Searching and compiling data in pharmaceutical sciences from various sources, analysis of collected information for presentation and rational discussion, topic must be different from that in 551 641 Seminar in Pharmaceutical Sciences I

### 551 643 Seminar in Advanced Pharmaceutical Sciences III 1(0-3-0)Condition: Non-credit course, assessed as S/U (for students enrolling in study plan 1.1 and 1.2)

Searching and compiling data in pharmaceutical sciences from various sources, analysis of collected information for presentation and rational discussion, topic must be different from that in 551 642 Seminar in Pharmaceutical Sciences II

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# 3(2-3-4)

### 551 644 Seminar in Pharmaceutical Sciences IV Condition: Non-credit course. assessed as S/U

# (for students enrolling in study plan 1.1 and 1.2)

Searching and compiling data in pharmaceutical sciences from various sources. analysis of collected information for presentation and rational discussion, topic must be different from that in 551 643 Seminar in Pharmaceutical Sciences III.

#### 561 401 **Advanced Cellular and Molecular Biology** 3(3-0-6)

Knowledge and developments in key areas of biochemical, biophysical and genetic processes within the cells, emphasizing structure and function of biomolecules, subcellular and cellular organization, protein synthesis, protein morphology and trafficking, cell motility, cell signaling and communication.

#### 561 403 1(1-0-2) **Instrumentation in Molecular Biology**

Principles and good practices of instrumentation in molecular biology studies.

### 561 502 **Advanced Human Physiology**

In-depth study of human organ systems and their functions at the molecular level, including current physiology concepts and research.

### 561 503 **Cellular and Molecular Biology for Biopharmaceuticals** 2(2-0-4) **Development**

Principle, applications and recent advancement of molecular biotechnology and genetic engineering for research; bioprocessing and quality control of biological products, applications of biopharmaceuticals for the diagnosis, prevention and treatment of diseases.

### 561 505 **Applied Microbiology**

Application of pathogenic and non-pathogenic microorganisms in food and pharmaceutical industry, environment and agriculture; utilization of advanced knowledge in microbiology, cellular microbiology, genetic engineering and microbial systems to produce pharmaceutical substances for disease diagnosis, prevention, and treatment.

### 561 506 **Applied Immunology**

Human immune system against infectious diseases, transplanted tumors and organ grafts, applications on prophylaxis and treatment, serological techniques and its applications.

### 561 507 **Molecular Virology**

Molecular biology of human pathogenic viruses covering structures, life cycles, mechanisms of viral pathology and antiviral approaches.

# 2(2-0-4)

2(2-0-4)

2(2-0-4)

# 1(0-3-0)

# 3(3-0-6)

#### 561 531 **Special Problems in Pharmaceutical Sciences I** 2(1-3-2)

Advanced research skills in special problems of interest, emphasizing technology and current protocol, planning, developing, data analysis and interpretation, data evaluation and presentation, and its application in pharmaceutical sciences.

#### 561 532 **Special Problems in Pharmaceutical Sciences II** 1(0-3-0)

Advanced laboratory course in special problems of interest, emphasizing technology and current protocol, and its application in pharmaceutical sciences research.

### 561 533 **Cellular and Molecular Biotechnology Laboratory** 1(0-3-0)Co-requisite: 561 503 Cellular and Molecular Biology for

**Biopharmaceuticals Development** 

Laboratory practices and technical approaches related to 561 503 Cellular and Molecular Biology for Biopharmaceuticals Development.

### 561 534 **Cellular and Molecular Bacteriology**

Basis of bacterial structures, genetics, evolution and pathogenicity; mechanisms of antibacterial agents and drug resistance, including basic laboratories and molecular biological methods for the researches in bacteriology.

### 561 535 **Applied Microbiology Laboratory** 1(0-3-0)Co-requisite: 561 505 Applied Microbiology Laboratory practices related to 561 505 Applied Microbiology.

### 561 601 **Signal Transduction**

Signal transduction pathways coordinating cellular activities as well as the roles of regulatory molecules and cross-talks between these pathways.

### 561 602 **Biological Assay**

Application of biological assay, including use of experimental animals, cell cultures and immunoassay for safety test and quality assurance of drugs, food, cosmetics, biological products, and quantitative measurement of biological substances in the body.

#### 561 603 **Advanced Application of Drug Biotransformation** 3(3-0-6)

Biotransformation of drugs and xenobiotics in normal and pathological state; mechanisms of biotransformation; factors affecting drug biotransformation; evaluation; application of biotransformation in research and development of new drugs, and in pharmacotherapy.

#### 561 604 **Advanced Cellular and Molecular Bacteriology** 1(1-0-2)

Analytical study and concepts in research development related to evolution and pathogenesis of bacteria, epidemiology of infectious diseases, mechanisms of antibiotic resistance, and antibacterial development for drug-resistant bacteria including new antibiotics, bacteriophage and vaccine.

### 2(2-0-4)

2(2-0-4)

# 2(1-3-2)

# 561 605 Current Topics in Advanced Biopharmaceutical Sciences 1(1-0-2)

Current topics in advanced science and technologies related to biopharmaceutical sciences, new concepts and related theories.

### 561 606Advanced Immunology

Holistic approaches in immune system functions and details at cellular and molecular levels of immune responses to infectious diseases, tumor, and immunopathology including mechanisms of immunomodulators.

# 561 631Bioinformatics in Pharmaceutical Sciences3(2-3-4)

Application of bioinformatics tools to compute and/or analyze biopharmaceutical data, data retrieving, sequence and structural analysis of genetic materials and protein, including design of experimental bioinformatics models.

| 561 632 | Biological Assay Laboratory                               | 1(0-3-0) |
|---------|---|----------|
|         | Co-requisite: 561 602 Biological Assay                    |          |
|         | Laboratory practices related to 561 602 Biological Assay. |          |

# 564 501Advanced Instrumental Method of Analysis4(2-6-4)

Principles and integrated theories of the applications of instrumentation in research and quality control of raw materials and pharmaceutical products, including organic compounds obtained from syntheses or natural sources.

# 564 502Advanced Organic Pharmaceutical Chemistry3(3-0-6)

Organic chemistry applicable to pharmaceutical sciences, principles of organic chemical reactions involved in the synthesis and analysis of drugs and natural products.

# 564 503Structure Elucidation of Organic Compounds3(3-0-6)Prerequisite: 564 501 Advanced Instrumental Method of Analysis

Structure elucidation and identification of organic compounds based on instrumental spectroscopic data, including chemical and physical properties of organic compounds.

# 564 504Advanced Drug Design

Integrated pharmaceutical concepts in design and modification of molecular structure of lead compounds for bioactivity optimization.

# 564 505 Special Problems in Advanced Pharmaceutical Chemistry 3(1-6-2)

Concepts, principles, and progress of pharmaceutical chemistry on topics of interest involving data collections, discussions, and laboratory applications.

# 564 506Current Topics in Pharmaceutical Chemistry2(2-0-4)

Current topics in science and technologies related to advanced pharmaceutical chemistry, new concepts and related theories.

3(3-0-6)

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3(3-0-6)

### 564 601 **Pharmaceutical Synthesis**

Principles and techniques in pharmaceutical synthesis, including chemical reactions, separation techniques, purification and identification.

### 565 603 Systemic Pharmacology

General principle of pharmacokinetics and pharmacodynamics, pharmacology of drugs acting on autonomic nervous system, central nervous system, cardiovascular and renal systems, endocrine system, immune system, gastrointestinal system, respiratory system as well as antimicrobial drugs and anticancer drugs.

### 565 604 **Advanced Pharmacology**

Advanced concepts and principles in pharmacology of drugs acting on autonomic nervous system, central nervous system, cardiovascular and renal systems, endocrine system, immune system, gastrointestinal system, respiratory system as well as antimicrobial drugs and anticancer drugs, emphasizing pharmacological study at organ, cellular, and molecular levels including medical genetics.

### 565 605 **Advanced Toxicology**

Mechanisms of cellular and molecular toxicity and adverse effects of drugs and chemicals; relationships between dosage regimen and biological responses; diagnosis, laboratory tests, therapy of toxic symptoms; environmental and food chain contaminants, pollution, and poison control, exposure prevention and safety evaluation.

#### 565 702 **Research Methods in Pharmacology and Toxicology** 2(1-3-2)

Techniques and experimental procedures for research in pharmacology and toxicology emphasizing the screening of pharmacologically active compounds and investigating the mechanisms of action, and toxicity testing.

#### 565 703 **Receptor Pharmacology and Signal Transduction** 3(3-0-6)

Receptor theory, concepts, principles of experimental approaches in pharmacology with an emphasis on receptor pharmacology, intracellular signaling, and mechanisms of drug action through signaling mediators at cellular and molecular levels.

### 565 706 **Principle and Applications of Toxicology**

Interdisciplinary science of toxicology, providing concepts concerning adverse effects of toxic agents on physiological systems and their basic applications.

#### 565 802 **Current Topics in Pharmacology and Toxicology** 2(2-0-4)

Current topics in advanced science and technology involved in pharmacology and toxicology including related new concepts and theories.

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# 3(2-3-4)

4(4-0-8)

### 4(4-0-8)

3(3-0-6)

# 2(2-0-4)

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#### 565 803 **Special Problems in Pharmacology and Toxicology** 2(0-6-0)

Selected research problems in pharmacology or toxicology emphasizing literature-based research on relevant pharmacology topics to enhance students' skill in research proposal preparation and presentation including the nature of the research field, study objective, methodology, and other topics related to the student's interest.

### 565 804 Genetic Technology and Gene Therapy

Theory, principles, and laboratory skills in genetic technology emphasizing applications of modern biological technology in pharmacotherapy and gene therapy.

### 566 401 Medical Herbs

Indigenous herbs of medicinal and economic interest, their applications and taxonomic identification, emphasizing Thai medicinal herbs.

### 566 501 **Chemistry of Natural Products**

Chemical constituents from natural sources emphasizing the chemicals possessing pharmaceutical and medical values.

#### 566 502 **Separation Techniques for Medicinal Plants** 3(2-3-4)

Theories and principle in isolation of chemicals from medicinal plants including applications of new separation technology for medicinal plant research.

### 566 503 **Advanced Research in Natural Products**

Systematic approaches in natural product researches emphasizing theory and application of advanced sciences.

#### 566 712 **Analysis of Natural Products** 3(2-3-4)

Principles and techniques used for the analysis of chemical constituents in natural products.

#### 566 732 **Biotechnology for Medicinal Plants Research** 3(2-3-4)

Application of plant biotechnology for medicinal plants research, micropropagation, production of valuable chemicals including the study of plant genomes.

### **Graduation criteria**

1. Accordance with the announcement of Ministry of Education as of standard regulation of graduate study 2558 BE. And/or updated amendment.

2. Accordance with Silpakorn University's 2007 Regulations on Graduate Study and/or later revision and/or updated amendment.

3. For students who receive the Royal Golden Jubilee Ph.D. Scholarship or other funding projects, graduation requirements of the scholarship will also apply.

# 3(2-3-4)

4(3-3-6)

3(2-3-4)

# 3(2-3-4)

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