

## **Year One Modules**

### **PHS1110 Foundation for Medicinal and Synthetic Chemistry**

*Pre-requisite: H2 Chemistry or equivalent*

This module covers essential topics in medicinal and synthetic organic chemistry that serve as the foundation for understanding the principles of drug discovery and development. Functional groups and ring structures are the key features that confer physicochemical and reactivity properties to chemical and biological drug molecules. Physicochemical properties that contribute to variation in drug likeness will be dealt with in detail. Functional groups and rings that are susceptible to structural derivatisation will be discussed in terms of the reaction mechanism involved illustrating how structural modifications can create better drug likeness.

### **PHS1111 Fundamental Biochemistry for Pharmaceutical Science**

*Pre-requisite: H2 Chemistry or equivalent*

This module is aimed to provide fundamental biochemistry knowledge which is important and relevant for pharmaceutical science students to relate the knowledge to drug discovery and development. The module will emphasise the relevance and application of biochemistry in pharmaceutical practices.

### **PHS1114 Principles of Pharmaceutical Formulations I**

*Pre-requisite: H2 Chemistry or equivalent*

This module gives insights into the pre-formulation considerations covering different physicochemical properties important to pharmaceutical formulation development, as well as giving an introduction to dosage forms including solutions and disperse systems. The fundamental knowledge of the physicochemical properties, manufacture, and applications of these dosage forms will be discussed.

### **PHS1120 Essential Topics in Pharmaceutical Chemistry**

*Pre-requisite: PHS1110*

This module adopts a biological approach to explain and illustrate foundational pharmaceutical chemical principles that are essential for the understanding of pharmaceutical science related to drug synthesis, drug properties, drug action and preparation of biomaterials. Three broad topics will be covered, including bio-organic chemistry, radical chemistry and enzymatic catalysis.

### **PHS1130 Human Physiology**

*Pre-requisite: Pharmaceutical Science Major or departmental approval*

This module is aimed to provide fundamental knowledge and understanding of the normal function of the human body. The underlying physiological processes within each of the following human body systems will be covered: 1. musculoskeletal system, 2. cardiovascular system, 3. blood and immune system, 4. respiratory system, 5. endocrine system, 6. digestive system, 7. renal system, and 8. nervous system.

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### **ST1232 Statistics for Life Sciences**

*Pre-requisite: GCE 'AO' Level or H1 Pass in Mathematics or its equivalent*

This module introduces life science students to the basic principles and methods of biostatistics, and their applications and interpretation. A computer package is used to enhance learning and to enable students to analyze real life data sets. Topics include probability, probability distributions, sampling distributions, statistical inference for one and two sample problems, nonparametric tests, categorical data analysis, correlation and regression analysis, multi-sample inference. This module is essential to students of the Life Sciences.

### **LSM2212 Human Anatomy**

*(Level 2000 module to be read in Year 1 of the Pharmaceutical Science programme)*

*Pre-requisite: GCE 'A' Level or H2 Biology or equivalent, or LSM1301 or LSM1301X, or Pharmaceutical Science Major*

This module provides a basic introduction to human structure and function, comprising gross anatomy integrated with microscopic anatomy. Histological organization of the primary tissues: epithelial, connective, muscular and nervous tissues will also be covered. Clinical relevance of the anatomical structures will be discussed.

## **Year Two Modules**

### **PHS2115 Basic Principles of Drug Design and Development**

*Pre-requisites: PHS1110*

This module will demonstrate the application of chemical and pharmacological sciences in the processes of drug discovery beginning from lead identification phase to pre-clinical study phase. The main learning will focus on how molecules are modified into potential drug candidates through achieving suitable pharmacodynamic and pharmacokinetic profiles. Approaches in pharmacophore identification and principles in lead optimisation will be introduced. Chemical diversity in drugs will be illustrated through a selection of commercially available drugs. Structure-activity relationship will be elucidated using drugs of different pharmacological actions. The approaches to how drug disposition (ADMET) is optimised in the pre-clinical phase will be highlighted.

### **PHS2117 Principles of Pharmaceutical Formulations II**

*Pre-requisite: PHS1114*

This module gives an introduction to solid dosage forms including tablets, capsules, powders and granules, as well as topical products and transdermal delivery. Formulations of emerging importance including biologics, polymers and biomaterials will be discussed. Fundamental knowledge of product quality and stability will be covered.

### **PHS2120 Drug Product Development & Lifecycle Management**

*Pre-requisite: PHS1110*

This module will provide the knowledge and understanding on the complete development plan ensuing successful lead identification in the drug discovery process, describing preclinical studies, formulation and product developments, clinical trials and post-marketing studies. The importance of quality, quality assurance and control and key global/regional regulatory frameworks and strategies for product development will be covered. Following post-marketing approval, upcoming innovative regulatory and marketing strategies for effective lifecycle management of a pharmaceutical such as improved patient compliance, revenue growth, expanded clinical benefits, cost advantages, life extension exclusivity etc. will also be introduced.

### **PHS2143 Analytical Techniques and Pharmaceutical Applications**

*Pre-requisite: PHS1110*

This module aims to train students in the principles and practical capability of pharmacopeia assays and various analytical instruments for pharmaceutical analysis. In particular, students will apply the analytical techniques in the characterization of active pharmaceutical ingredient (API), the quality assurance of dosage forms and the analysis of biological fluids, coupled with hands-on experience with instrumentation and real-life problem solving.

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### **PHS2191 Laboratory Techniques in Pharmaceutical Science I**

*Pre-requisites: PHS1120 and PHS2143*

This module introduces the theory and practical applications of major tools and techniques used in the continuum of drug discovery and development. Factual knowledge in pharmaceutical/medicinal chemistry techniques, such as synthetic skills, lead optimization, molecular modelling, will be integrated with laboratory practice.

### **LSM2241 Introductory Bioinformatics**

*Pre-requisite: PHS1111*

Students will be introduced to the concepts, tools and techniques of bioinformatics, a field of immense importance for understanding molecular evolution, individualized medicine, and data intensive biology. The module includes a conceptual framework for modern bioinformatics, an introduction to key bioinformatics topics such as databases and software, sequence analysis, pairwise alignment, multiple sequence alignment, sequence database searches, and profile-based methods, molecular phylogenetics, visualization and basic homology modelling of molecular structure, pathway analysis and personal genomics. Concepts emphasized in the lectures are complemented by hands-on use of bioinformatics tools in the practicals. Students will achieve highly valued skills as biological researchers with basic competence in computational and bioinformatics techniques, with proper foundation to learn more advanced skills in bioinformatics and biocomputing.

### **LSM3211 Fundamental Pharmacology**

*(Level 3000 module to be read in Year 2 of the Pharmaceutical Science programme)*

*Pre-requisite: PHS1111*

This module aims to provide basic principles of receptor pharmacology and of pharmacokinetics with emphasis on molecular and cellular mechanisms of action, clinical uses and adverse effects using lectures, tutorials and practicals. The lecture topics will start with the classical drug receptor theory followed by pharmacokinetics and molecular pharmacology of drug receptors and their regulation including receptor-mediated signal transduction and membrane ion channel function. Autonomic pharmacology (adrenergic and cholinergic) will be introduced. The module also focuses on the pharmacology of autacoids, non-steroidal anti-inflammatory agents, corticosteroids, immunosuppressants, anti-asthma drugs, and anti-arthritic drugs.

## **Year Three Modules**

### **PHS3116 Pharmacokinetics and Biopharmaceutics**

*Pre-requisite: LSM3211 Fundamental Pharmacology or departmental approval*

This module provides students with a comprehensive foundation of the concepts of pharmacokinetics and biopharmaceutics. The application of these concepts are important in the drug discovery and development process. Major topics include: basic principles, concepts and processes of drug absorption, distribution, metabolism and excretion, kinetics of drugs following intravascular and extravascular routes of administration, design of appropriate dosage regimens, and application of pharmacokinetic concepts in drug design and development.

### **PHS3122 Pharmaceutical Quality Management**

*Pre-requisite: PHS2120*

The aim of this module is to provide an understanding of the important guidelines, tools and practices of quality risk management that can be applied to all aspects of pharmaceutical quality including development, manufacturing, distribution, and the inspection and submission/review processes throughout the lifecycle of drug. The module will cover the history and philosophy of product quality management, the concept of quality by design, overview of major quality management systems such as "Six Sigma", "Total Quality Management", "Lean Management" etc. The module will also provide an overview of various types of audits and inspections that occur in the pharmaceutical industry.

### **PHS3123 Biotechnology for Pharmaceutical Science**

*Pre-requisite: PHS1111*

Students will gain knowledge of the various techniques in biotechnology and their applications in the manufacturing of biopharmaceuticals and biomedical research, the physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals, as well as the principles of the mechanism of some biotechnologically derived diagnostic aids/tests. Major topics to be covered include biotechnologically derived therapeutics such as insulin, growth hormones, cytokines, enzymes, monoclonal antibodies, vaccines, blood products, diagnostic aids/tests for urine analysis, plasma glucose, plasma lipids, HIV and pregnancy, as well as gene therapy, transgenic technology, gene silencing and gene editing technology.

### **PHS3191 Laboratory Techniques in Pharmaceutical Science II**

*Pre-requisite: PHS2191*

This module extends from PHS2191 to introduce the theory and practical applications of further major tools and techniques used in the continuum of drug discovery and development. Factual knowledge in drug metabolism and pharmacokinetic techniques, such as enzyme kinetics, CYP inhibition, drug-drug interaction assays; and in pharmaceutical biology, such as cell viability/toxicity testing, DNA extraction and purification, aseptic techniques/cell culture, will be integrated with laboratory practice.

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### Elective Modules (Pass any 1)

#### **PR3204 Medicinal Natural Products**

*Pre-requisites: PHS1110 and PHS2143*

This module focuses on the study of medicinal constituents that are derived from herbs that possess therapeutic value. Examples of how these natural products are used as sources for modern drug development will be covered. The module also provides information on how these constituents are extracted, standardized and formulated into various dosage forms which are convenient for clinical use. Students will gain an appreciation of how quality and efficacy of such medicinal products are assured during the manufacturing processes to ensure patient safety and effective outcomes.

#### **PHS3220 Microbiology for Pharmaceutical Science**

*Pre-requisites: PHS1114 or departmental approval*

This module aims to equip students with knowledge and practical skills in the fundamentals of pharmaceutical microbiology and controls in microbial contamination of pharmaceutical products, medical devices and the environment. This module will give an insight into the nature of microorganisms, with greater emphasis on bacteria and their significance to the pharmaceutical industry and medicine. It will discuss the characteristics and morphology of microorganisms, their growth requirements, reproduction, enumeration and identification and relate this knowledge to disinfectants and disinfection, and the concept of sterility and sterilization methods for pharmaceutical products and medical devices.

#### **LSM3223 Immunology**

*Pre-requisite: PHS3123*

This course provides the central concepts of immunology and the foundation for understanding how immunity functions. The subjects of innate immunity and haematopoiesis introduce the origin and role of different cell types in immunity. The mechanisms of how the body protects itself from disease are explored in relation to T and B cell biology, antibodies, cytokines, major histocompatibility complex and antigen presentation. Other topics include hypersensitivity, immunodeficiencies, tolerance, autoimmunity, resistance and immunization to infectious diseases.

#### **LSM3224 Molecular Basis of Human Diseases**

*Pre-requisite: PHS3123*

This module aims to provide students primarily with in-depth knowledge of the basic molecular mechanisms of common human diseases, such as cancer, atherosclerosis, obesity, diabetes, and muscle wasting conditions; and to prepare them for future translational research. There will be extensive discussion on results from current cutting-edge research. Since the focus of this module is on the current molecular mechanisms underlying the pathogenesis of each disease, prospective students should have basic knowledge of molecular and cell biology, genetics and general human physiology before registering for this module.

*(Updated: 10 December 2020)*

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### **LSM3231 Protein Structure and Function**

*Pre-requisite: PHS1111*

*[Note: PHS students interested in LSM4241 Functional Genomics or LSM4242 Protein Engineering as Level 4000 electives must first read LSM3231 as Level 3000 elective]*

This module aims to provide a strong foundation in the study of protein structure and function. The following topics that will be covered: structures and structural complexity of proteins and methods used to determine their primary, secondary and tertiary structures; biological functions of proteins in terms of their regulatory, structural, protective and transport roles; the catalytic action of enzymes, their mechanism of action and regulation; various approaches used in studying the structure-function relationships of proteins.

### **CM3242 Instrumental Analysis II**

*Pre-requisite: CM2142 or CM2192 or LSM2191 or departmental approval*

*[Note: PHS students interested in CM4241 Trace Analysis or CM4242 Advanced Analytical Techniques as Level 4000 electives must first read CM3242 as Level 3000 elective]*

Instrumentation-based analytic techniques are essential for research & development, and for process/product control in manufacturing. These techniques are widely deployed in the chemicals, electronics and other manufacturing industries. Students will learn the principles, instrumentation and applications of the key analytical techniques including atomic and molecular spectrometries, basic mass spectrometry, electrochemical and thermal analysis methods. Students will also learn the extraction and separation techniques for sample preparation needed for these analyses. Students will also receive in-depth hands on training in selected techniques.

### **SPH3403 Public Health Economics**

This course will discuss key concepts that economists use to analyze the production and consumption of health and health care and apply these concepts to selected issues in health policy. We will first cover the microeconomic fundamentals that drive patient choices, provider and behavior, health insurance and medical innovation. The second part of the semester will shift to a macroeconomic perspective on systems and policy, and the third will conclude with a discussion the economic evaluation of health technologies and public health interventions.

### **SPH3501 Introduction to Public Health Communication**

This module equips students with the principles and skills to design health communication messages and activities/projects e.g. talks, skills development, telehealth in a variety of settings such as the school, workplace, internet and the community. It emphasizes the critical analysis and application of health communication theory and social marketing principles in the design of messages and communication projects to promote health in the community.

*(Updated: 10 December 2020)*

## **Year Four Modules**

### **PHS4121 Regulation of Healthcare Products**

*Pre-requisite: PHS2120*

The availability of healthcare products is governed by the regulations of individual jurisdictions, resulting in the disparity of requirements hindering the access of valuable therapeutics to patients. As such, the development of therapeutics should always consider the regulations involved and the impact to the timely availability to patients, and eventually the effectiveness of the healthcare system. This module aims to introduce the fundamental concepts of regulatory affairs, covering major frameworks, trending innovation in regulatory processes, key influencers and concerns arising from gaps in regulatory capacities. This knowledge expands on the understanding of product life cycle management, and enables a further appreciation of the intricate relationships among stakeholders in healthcare.

### **PHS4199 Honours Project in Pharmaceutical Science**

*Pre-requisite: Completion of PHS Year 3 requirement and subject to departmental approval*

This module aims to nurture the passion of final year students for inquiry and knowledge creation through fostering their intellectual rigor in tackling research questions related to pharmacy and pharmaceutical sciences, and developing their academic communication skills. It also aims to not only provide hands-on research experience gained through project work, but also to develop students' higher order thinking skills, such as the critical evaluation of information, as well as hone students' written and oral academic communication skills in the context of pharmaceutical sciences and practice. Students will carry out their projects under the supervision of Pharmacy academic staff.



**Elective Modules (Pass any 2)**

**PR4204 Special Drug Delivery**

*Pre-requisite: PHS2117*

The aim of this module is to provide an understanding of the science and technology of rate-controlled administration of therapeutic agents with comprehensive coverage of the basic concepts, fundamental principles, biomedical rationales and potential applications. Major topics include: Fundamentals of rate-controlled drug delivery; major delivery systems such as parenteral, oral and aerosols.

**PR4205 Bioorganic Principles of Medicinal Chemistry**

*Pre-requisites: PHS2115*

Learning objectives: To learn the different approaches in the design of drugs that are capable of interacting specifically with enzymes, DNA and other cellular targets. Major topics: A mechanistic, chemical and biochemical approach to medicinal chemistry, emphasizing enzymatic and macromolecular targets of drug action. Peptide, peptidomimetics and oligonucleotides.

**PR4207 Applied Pharmacokinetics and Toxicokinetics**

*Pre-requisite: PHS3116*

This module provides students with the knowledge of pharmacokinetics and its application in toxicology. It will enable students to develop critical thinking in optimization of pharmacotherapy for patients and educate students in evidence-based judgement in future clinical practice. Major topics include: Principles of clinical pharmacokinetics; principles of clinical toxicokinetics; pharmacokinetic/pharmacodynamic modelling; kinetics of drug interactions; interspecies pharmacokinetic scaling; bioactivation of drugs and toxicity relevance; genomics and variable drug response; management of patients with adverse drug events and drug toxicity.

**PHS4220 Synthetic Strategies for Drug Substances**

*Pre-requisite: PHS1110*

This module focuses on synthetic strategies for the construction and synthesis of new bioactive small molecules with potential therapeutic properties. It also covers topics in peptide and oligonucleotide syntheses which are fundamental in the production of some small sized biologics. The module supplements knowledge in medicinal chemistry to give students an appreciation on how to manipulate molecules through chemical synthesis to achieve better bioactivity.

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### **LSM4241 Functional Genomics**

*Pre-requisite: LSM3231 [PHS students must read LSM3231 as a Level 3000 elective first] or LSM3241*

This module aims to introduce selected topics on functional genomics. Areas covered include: the assignment of functions to novel genes following from the genome-sequencing projects of human and other organisms; the principles underlying enabling technologies: DNA microarrays, proteomics, protein chips, structural genomics, yeast two-hybrid system, transgenics, and aspects of bioinformatics and its applications; and to understand the impact of functional genomics on the study of diseases such as cancer, drug discovery, pharmacogenetics and healthcare.

### **LSM4242 Protein Engineering**

*Pre-requisite: LSM2232 or LSM3231 [PHS students must read LSM3231 as a Level 3000 elective first]*

This module will familiarize students with the technologies that can be used to produce and engineer various proteins for basic biological research and biotechnology applications. The fundamental principles for manipulating protein production as desired and the common expression systems will be presented. The emphasis will be on the experimental strategies and approaches to improve protein properties and to create novel enzymatic activities. The topics include gene expression and protein production systems, uses of gene fusions for protein production and purification, directed molecular evolution and DNA shuffling, and engineering of proteins and enzymes for improved or novel properties. Some specific examples in protein engineering will be highlighted.

### **CM4227 Chemical Biology**

*Pre-requisite: CM1121 or CM1401 and LSM1101 or LSM1401 or departmental approval*

This module provides an overall view on an emerging new discipline that blends chemistry with many fields of biology to unravel the complexities of life at the interface of chemistry and biology. This course illustrates how biological processes are explained in chemical terms. The key objective is to highlight the basic principles of chemical biology to show its important linkages to life sciences.

### **CM4241 Trace Analysis**

*Pre-requisite: CM3242 [PHS students must read CM3242 as a Level 3000 elective first]*

Chemical trace analysis is the use of analytical techniques to detect and/or quantify the presence of very low concentrations of substances. This is important in various industries, including for quality assurance, environmental monitoring, food and biomedical/pharmaceutical safety. Students will learn the principles, instrumentation and applications of trace analysis of both inorganic and organic contaminants, including: sample preparation, measurement methodologies, including isotope dilution, chemosensors and biosensors, matrix effects, sampling bias & statistical evaluation. Students will also receive practical training in trace analysis methodology and instrumentation.

## Bachelor of Science (Pharmaceutical Science) For Cohort AY2020/21

### **CM4242 Advanced Analytical Techniques**

*Pre-requisite: CM3242 [PHS students must read CM3242 as a Level 3000 elective first]*

Advanced mass spectrometric methods, and scanning probe microscopies form an important group of advanced analytical techniques widely used for research & development, and also for process/product control in advanced manufacturing industries. Microfluidics & labchip techniques, in particular, are increasingly used for biochemical assays in biomedical devices. Students will learn the principles, instrumentation and applications of these techniques, and receive in-depth training in selected advanced analytical techniques, including advanced mass spectrometry (ICP-MS).

### **SP4263 Forensic Toxicology and Poisons**

*Pre-requisite: LSM1306 or departmental approval*

Ever wondered how much of the coffee you consumed is subsequently metabolised? Find out using forensic toxicology! This multi-disciplinary module aims to support medical and legal investigation into the cause of death, poisoning and adverse responses to substances. Drawing from the foundational principles in toxicokinetics, students will be able to (1) study the physicochemical properties of substances and their effect(s) on the host and (2) consider the toxicological outcomes of exposure due to the unique handling of substances by organ systems. The lectures will conclude with real-life applications led by practitioners.

### **CS4220 Knowledge Discovery Methods in Bioinformatics**

*Pre-requisite: CS2220 or LSM2241*

The advent of high throughput technologies (e.g., DNA chips, microarray), biologists are being overloaded with information (e.g., gene expression data). A systematic way is needed to analyze the data to make sense of them. This module is introduced to provide students with knowledge of techniques that can be used to analyse biological data to enable them to discover new knowledge. At the end of the module, students will be able to identify the relevant techniques for different biological data to uncover new information. Topics include: Clustering analysis, classification, association rule mining; support vector machines; Hidden Markov Models.