亞洲大學

108 學年度生物資訊與醫學工程學系博士班課程規劃表

Approved by the University Curriculum Committee meeting on 05/06/2019

課程名稱: 生物資訊與醫學工程學系-博士學位

Ph.D. Program in Bioinformatics and Medical Engineering

類別 Category	科目名稱 Course Title	英文名稱 English Course Title	修課年級 Year of the Program	修課學期 Semester	學分數 Credits	每週上課時數 Hours per week		備註 Remarks
						講授 Lecture	實驗 Experiment	
(2) University Required Credits	博士論文	Doctoral Dissertation	1st	2nd	3	0		
	博士論文	Doctoral Dissertation	2nd	1st	3	0		
(3) Program Required Credits	論文研討(一)	Seminar I	1st	1st	1	1		
	論文研討(二)	Seminar II	1st	2nd	1	1		
	論文研討(三)	Seminar III	2nd	1st	1	1		
(21) Program Elective Credits	醫學工程概論	Introduction to Biomedical Engineering	1st / 2nd	1st / 2nd	3	3		
	醫學影像基本原理與儀器	Basic Theories of Biomedical Images and instruments	1st / 2nd	1st / 2nd	3	3		
	生醫感測技術概論	Introduction to Biosensing Technology	1st / 2nd	1st / 2nd	3	3		
	醫療器材開發	Introduction to Medical Device Development and Regulation	1st / 2nd	1st / 2nd	3	3		
	生醫材料概論	Introduction to Biomaterials	1st / 2nd	1st / 2nd	3	3		
	分子生物學	Molecular Biology	1st / 2nd	1st / 2nd	3	3		
	生物資訊學	Bioinformatics	1st / 2nd	1st / 2nd	3	3		
	生物化學	Biochemistry	1st / 2nd	1st /2nd	3	3		
	分子醫學	Molecular Medicine	1st / 2nd	1st / 2nd	3	3		
	體學	Omics	1st / 2nd	1st /2nd	3	3		
	細胞生物學	Cell Biology	1st / 2nd	1st /2nd	3	3		
	系統生物學	Systems Biology	1st / 2nd	1st / 2nd	3	3		
	機器學習	Machine Learning	1st / 2nd	1st / 2nd	3	3		
	生物技術導論	Introduction to Biotechnology	1st / 2nd	1st / 2nd	3	3		
	藥物設計概論	Introduction to Drug Design	1st / 2nd	1st / 2nd	3	3		
	生醫訊號處理	Biomedical Signals Processing	1st / 2nd	1st / 2nd	3	3		
	資料探勘	Data Mining	1st / 2nd	1st / 2nd	3	3		
	生醫影像處理	Biomedical Image Processing	1st / 2nd	1st / 2nd	3	3		
	生物資訊演算法	Bioinformatics Algorithms	1st / 2nd	1st / 2nd	3	3		
	計算分子生物學	Computational Molecular Biology	1st / 2nd	1st / 2nd	3	3		
	高等資料庫系統	Advanced Database Systems	1st / 2nd	1st / 2nd	3	3		
	生物資訊程式設計	Bioinformatics Programming	1st / 2nd	1st / 2nd	3	3		

	分子演化	Molecular Evolution	1st / 2nd	1st / 2nd	3	3		
	生物資訊統計分析	Statistical Analysis in Bioinformatics	1st / 2nd	1st /2nd	3	3		
	仿生計算	Biologically Inspired Computing	1st / 2nd	1st /2nd	3	3		
	生物技術專題講座(一)	Biotechnology Seminar I	1st / 2nd	1st /2nd	3	3		
	生物技術專題講座(二)	Biotechnology Seminar II	1st / 2nd	1st /2nd	3	3		
	類神經網路	Artificial Neural Networks	1st / 2nd	1st /2nd	3	3		
	生醫光學概論	Introduction to Biooptics	1st / 2nd	1st /2nd	3	3		
	機器人計算學	Robotic Computing	1st / 2nd	1st /2nd	3	3		

註：

1. 本地生欲修習全英文課程，英文成績須達多益 650 分、托福紙筆測驗 500 分、全民英檢中級或其他相同等級之英檢或經系主任面談後，開給同意書。
2. 總畢業學分數為 24 學分(含專題討論 3 學分及博士論文 6 學分)
3. 學生畢業需通過畢業論文或技術報告。

Taiwanese students, who want to join English-taught program, shall meet one of the language requirements, indicated below: TOEIC-650 / TOEFL-500 (paper-based)/ GEPT-Intermediate Level/Equivalent test score of other English proficiency tests/A letter of authorization.

Graduation requirement: 24 credits (include 3 credit hours seminar, 6 credit hours thesis)

系所主管簽章: 學院院長簽章: 國際學院院長簽章:

Course Descriptions

Course Title	Course description
Artificial Neural Networks 類神經網路	Basic concepts in neural computing; functional equivalence and convergence properties of neural network models; associative memory models; associative, competitive and adaptive resonance models of adaptation and learning; selective applications of neural networks to vision, speech, motor control and planning; neural network modeling environments. Students will understand the basic concepts, principles, mathematical models, and applications of some classical neural network models. Students will gain experience of applying neural networks to problem solving using MATLAB. Students will understand practical applications and have interests by reading articles.
Bioinformatics 生物資訊學	This course covers the following topics: sequence alignment, dynamics programming, NCBI database, gene annotation, gene prediction, molecular phylogenetics, protein structure, and RNA structure.
Introduction to Biomaterials 生醫材料概論	Biomaterials are materials (synthetic and natural; solid and sometimes liquid) that are applied in medical devices or in contact with biological systems. Biomaterials as a field has seen steady growth over its approximately half century of existence and uses ideas from materials science, chemistry, biology, medicine and engineering. This course provides students with a perfect introduction to the world of biomaterials, linking the basic characteristics of metals, polymers, ceramics and natural biomaterials to the unique advantages and limitations of their biomedical applications. The clinical issues such as sterilization, surface modification, cell-biomaterial interactions, drug delivery systems, and tissue engineering have been discussed in detail so that students have a practical understanding of the real world challenges associated with biomaterial engineering. The purpose of the course is to provide students with the special meaning of the term biological material, as well as the rapid and exciting evolution and expansion of biomaterial science and its application in medicine. At the end of the semester, all students should identify and understand the main terms used primarily in the biomaterials, the basic properties of the various biological materials, the correct association of the terms with the process / phenomenon, and the ability to correlate the relevant events.
Bioinformatics Algorithms 生物資訊演算法	This course highlights how a biological problem can be transformed into a computational problem in a number of ways that feature different levels of accuracy and complexity. Highly accurate models often result in intractable computational problems while less accurate models may produce meaningless results. The main goal is to maintain an acceptable level of accuracy keeping the computational problem effectively solvable.
Biologically Inspired Computing 仿生計算	Biological organisms cope with the demands of their environments using solutions quite unlike the traditional mathematical approaches to problem solving. Biological systems tend to be adaptive, reactive, and distributed. Bio-inspired computing is a field devoted to tackling complex problems using computational methods modeled after design principles encountered in nature. The goal is to produce informatics tools with enhanced robustness, scalability, flexibility and which can interface more effectively with humans. Students will be introduced to fundamental topics in bio-inspired computing, which gives students a chance to observe and compare different natural behaviors that can be utilized for computation. Students will build up their proficiency in the application of various algorithms in real-world problems. Through the study of animal behaviors, students will be interested in the beauty of natural phenomena, which are in essence highly excellent optimizers.
Introduction to	This course is designed for the students who does not have basic knowledge of bio-

Biooptics 生醫光學概論	optics. This course will provide introduction to make students have a basic knowledge of optics and understand the biomedical applications of optical techniques. In this course, students can learn how to get the images and data through optical instruments. To arise the learning interests of students, some novel optical biomedical sensing technologies will be lectured in this course. Students need to read some review papers of optical techniques and give presentations in the weeks of the midterm and final exams. In the end of this course, students should know the principles of optical techniques, the applications of optical techniques, the development of biooptics, and the advantages and disadvantages of these optical techniques.
Biotechnology Seminar (I) (II) 生物技術專題講座(一) (二)	This course is designed for non-biology students, such as from computer science, engineering, mathematics and others. This course will provide introduction to the current trends in Biotechnology researches and their application. At the end of this course students will gain basic level knowledge in Biotechnology and applying these to their research.
Biomedical Image Processing 生醫影像處理	This course is designed for the students who have basic programming skill and interest in the digital image processing technology. This course will provide introduction to educate students have a broad understanding in image processing technology. In this course, students need to learn the program writing skill with the Matlab language and use Matlab program to carry out image processing assignments. The course will combine examples and exercises in teaching, so that students can learn the theory and application of technology at the same time. Students need to complete several homework assignments and also have to submit the midterm and final reports. In the end of this course, students should learn the basic principles of medical images, the use of Matlab programming language, basic skills of analyzing images and the reconstruction of a 3D object from images.
Introduction to Biosensing Technology 生醫感測技術概論	This course developed to present a basic understanding of bio-sensor principles and applications. The research and development in the bio-sensors is an extremely dynamic area of current science and technology. This course is divided into two main categories—(1) theoretical understanding of various physical and chemical phenomena behind the operation of different types of sensors and micro-systems, (2) designing of sensors with appropriate electronic interface as a complete system. To enable students to understand the biomedical sensing technologies currently used in the biological medicine, and have basic concepts for these theoretical foundations. To teach students to understand how to get these sensing data via the introduction of this course, and have complete and correct concepts for these technologies. To teach many kinds of medical sensing technologies for arousing students learning interest in biomedical detection technology.
Basic Theories of Biomedical Images and instruments 醫學影像基本原理與儀器	This course is designed for the students who interest in the imaging systems used in the hospital. This course introduces basic medical image processing concepts and imaging techniques. Principals of X-ray, computerized tomography, magnetic resonance imaging ultrasound imaging, optical coherence tomography and so on will be lectured in this course. This course also introduce some common used image processing methods for biomedical images. Students need to read some review papers of imaging technologies and give presentations in the weeks of the midterm and final exams. In the end of this course, students should know the principles of imaging techniques, instruments, and the basic concepts for medical image processing.
Cell Biology 細胞生物學	This course is designed for non-biology students, such as from computer science, engineering, mathematics and others. This course will provide introduction to the structure and biology of eukaryotic cell, with special focus on the cell/cell and cell/ECM interaction, endomembrane trafficking, cytoskeleton and signal transduction pathways. At the end of this course students will gain basic level knowledge in cell biology and

	applying these to their research.
Data Mining 資料探勘	Data mining, or called knowledge discovery, is the processes of analyzing data from different perspectives, deriving useful information, and finally acquiring knowledge. The applications of data mining are now prevalent in varied domains, such as stock prediction, customer behavior analysis, and social network. In this course, we will learn what data mining can do and how to do it. Some important concepts and techniques, including association rules, clustering, classification, and artificial intelligence, will be discussed.
Introduction to Medical Device Development and Regulation 醫療器材開發	This course introduces the design and application of medical devices, and include the relevant laws and regulations. Therefore, students can understand the requirement to comply with these norms, and they can design products to meet the regulatory requirements in the future. The lectures in this course includes the basic concepts of medical instrumentation, principles of basic sensors, amplifiers and signal processing, origin of biopotential and so on. After learning this course, the students should obtain the foundations necessary to build a strong understanding of the development of medical devices.
Molecular Biology 分子生物學	This course is designed for non-biology students, such as from computer science, engineering, mathematics and others. This course will provide introduction to the molecular basis of life and inheritance, with a detail in the structure and function of biological macromolecules and the biochemical mechanisms that control the maintenance and expression of genome in prokaryotes and eukaryotes. Topics in replication, dynamics of chromosome structure, regulation of gene expression will be discussed. Students will be able to use the knowledge they have acquired to develop projects in bioinformatics. At the end of this course students will gain basic level knowledge in molecular biology and applying these to their research.
Molecular Medicine 分子醫學	The goal of this course is to discuss the aspects of molecular medicines from the causes, development and diagnosis through to the treatment of diseases, with special focus on the overview of the molecular mechanisms incorporating modules from immunology to signaling, from virology to gene therapy, and the latest development in personalized medicine introduction into the molecular basis of diseases and the novel treatment options that have become available. This includes an analysis of cellular structures and organelles, protein structures and functions, nucleic acid biochemistry, replication and repair of DNA, the processes of transcription and translation, regulation of gene expression, modern molecular techniques used for diagnosis and research, proteins, purines and pyrimidines, and human genetics. After having completed this course, the students shall have obtained a basic understanding of various human diseases and the underlying molecular, genetic or biochemical basis for the pathogenesis of the clinical disorders and their possible treatments.
Omics 體學	This course is designed for students who major in engineering and science. Omics is a new area of study in molecular biology that examine the feature of a large family of biological molecules, such as DNA, mRNA, proteins, metabolites, lipids and carbohydrates (saccharides). This course is designed to give students a general understanding of the genomes, transcriptomes, proteomes and their integration, i.e. omic. Genomes, transcriptomes, proteomes are the large-scale study of genes, transcripts and proteins. In addition, this course will also cover the following topics: regulatory elements, epigenetic mechanism (DNA methylation, chromatin modeling), and non-coding RNA biology. Networks of interactions are fundamental to all biological processes. In the last ten years, we began to see much progress in analyzing biological networks using the random graph approach. Network motifs are patterns that occur

	more often than their randomized parts. A complex network can be characterized by certain topological measurements. Students will learn those techniques in the course.
Robotic Computing 機器人計算學	Robotic Computing addresses computing technologies, and their synergetic interactions, that enable and are enabled by human like robots. The scope of this course includes, but is not limited to, perception, semantic content understanding and delivery, reasoning, planning, problem solving, learning, human-robot interaction and domain specific applications in home, healthcare, business, entertainment, business, education, industry, etc. The recent success of AlphaGo and advances in artificial intelligence, cloud computing, mobile computing, cognitive computing, semantic computing and other related areas have demonstrated that the era of robots is emerging. The course will give an introduction to the relevant technologies so that students have required concepts to study further. Practical demonstrations and applications will trigger students' learning motivation.
Seminar (I)(II)(III) 專題討論(一)(二)(三)	This course will help graduate students to develop their independent research ability. Students will have to present their papers related to the major topics in either bioinformatics or biomedical research.
Systems Biology 系統生物學	Networks of interactions are fundamental to all biological processes; for example, the cell can be described as a complex network of chemicals connected by chemical reactions. Cellular processes are controlled by various types of biochemical networks: (i) metabolic networks; (ii) protein-protein interaction networks (PIN), and (iii) gene regulatory networks. Complex networks are found throughout biology. Many biological networks seem to have underlying modularity structure. Each module is expected to perform a specific function, separable from the functions of other modules. This course will cover the following topics, including network biology, random graph theory, network perturbations, network motifs structures, network complexity and network enrichment analysis. Students will learn how to analyze biological systems from a system level perspective.

Faculty Members

Instructor's title	Instructor's name	Contact Information
President / Professor 校長 / 教授	Dr. Jeffrey J.F Tsai 蔡進發	Email: president@asia.edu.tw
Professor 教授	Dr. Phillip C-Y. Sheu 許承瑜	Email: psheu@uci.edu
Professor 教授	Dr. Ka-Lok Ng 吳家樂	Email:ppiddi@gmail.com
Professor 教授	Dr.Ching-Wen Lou 樓靜文	Email: cwlou@asia.edu.tw
Professor 教授	Dr. R. M. Hu 胡若梅	Email: rmhu@asia.edu.tw
Associate Professor 副教授	Dr. W. P. Hu 胡文品	Email: wenpinhu@asia.edu.tw
Associate Professor 副教授	Dr. Yu-Ching Chen 陳玉菁	Email: yuching33@ gmail.com
Associate Professor 助理教授	Dr. Wen-Ling Chan 詹雯玲	Email: wlchan@asia.edu.tw
Assistant Professor 助理教授	Dr. Wen-Yu Su 蘇文郁	Email: d91548099@ntu.edu.tw
Assistant Professor 助理教授	Dr. Che-Nan Kuo 郭哲男	Email: cnkuo@asia.edu.tw
Assistant Professor 助理教授	Dr. Yu-Lin Song 宋昱霖	Email: ylsong@asia.edu.tw
Assistant Professor 助理教授	Dr. Yu-Fang Shen 沈育芳	Email: cherryuf@gmail.com
Assistant Professor 助理教授	Dr.Charles C.N. Wang 王昭能	Email: chaoneng.wang@gmail.com
Assistant Professor 助理教授	Dr.Rathinasamy Baskaran	Email: baskaran@asia.edu.tw